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Single-head Automatic Gaining Machine.

The accompanying engraving represents a complete and convenient single-head automatic gaining machine, especially designed for carpenters, car and ship builders, wagon, truck, carriage, agricultural implement manufacturers and general woodworkers, for cutting gains, grooves, tenons and miters—either square, angular or double angular—in either hard or soft wood, from the most delicate sizes up to 8 inches wide, 3 inches deep, and from 1 inch to 24 inches long, and performing the work true and smooth without slivering. Cutter heads can be used for any class of work in this line, or by the use of a cut-off saw, it can be utilized for cutting off timber.

It is adapted for cutting gains or grooves of an equal depth over the surface of warped boards, as shown by the sample of work at the base of the machine.

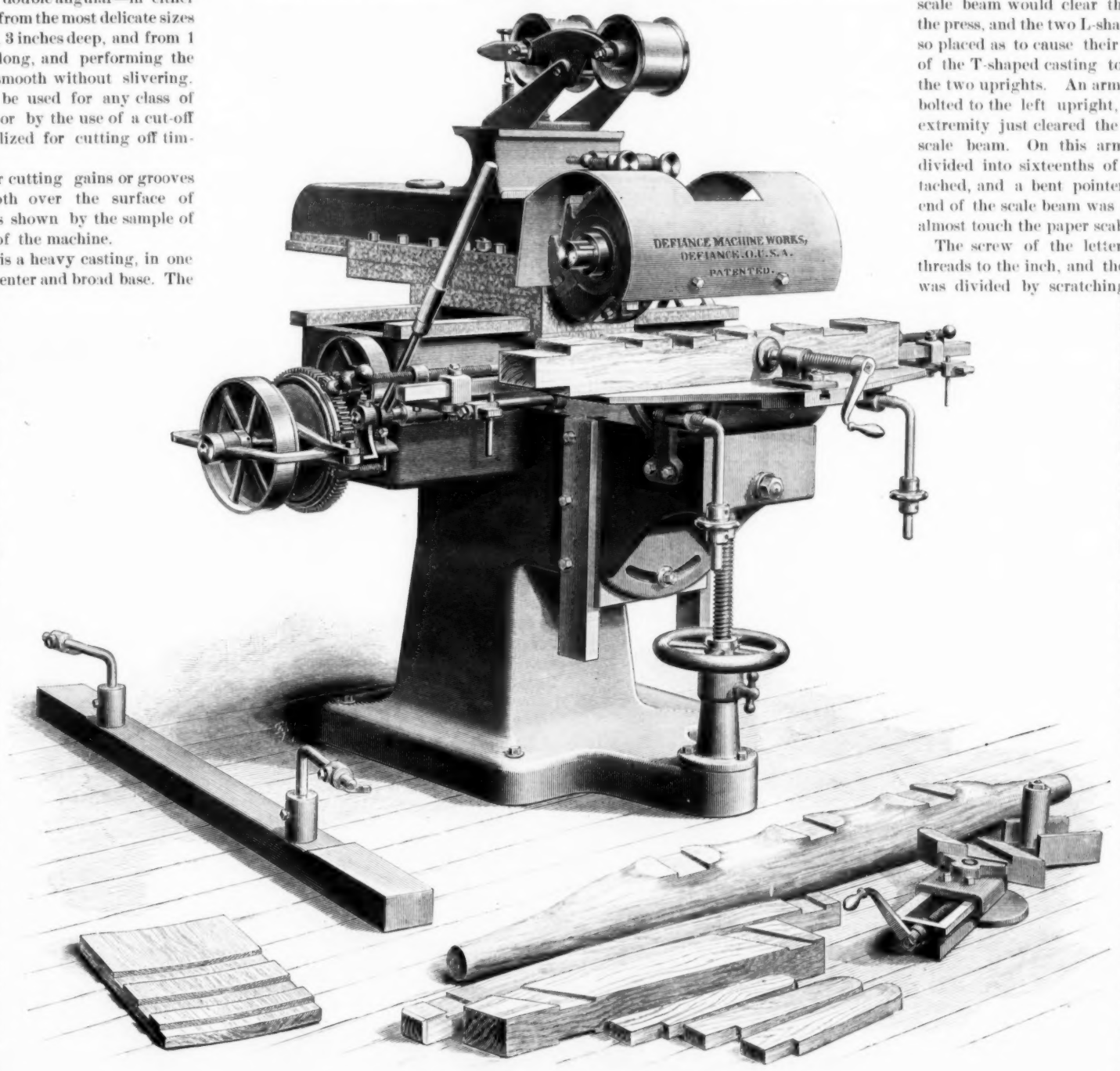
The main frame is a heavy casting, in one piece, with cored center and broad base. The top portion of the frame is planed true and accurately fitted for the support of the carriage, which is gibbed to it, and adjustable over its entire length by a hand wheel and screw to adjust the head to any portion of the work without moving the latter on the table.

The cutter head spindle, of steel, is $1\frac{5}{16}$ inches diameter by 24 inches long, and the cutter head may be used on either end, or one at each end of the spindle to cut two gains at one time, or can be placed between the bearings with the driving pulley outside, as may best suit the nature of the work.

The sliding ram by which the cutter head is carried is fitted with a device whereby the travel of the head may be quickly adjusted from 1-inch to 24-inch stroke, and it is provided with a quick return movement. The ram can be set to any desired angle for the purpose of cutting angular gains.

The table bracket is fitted to the frame in gibbed ways and is adjustable up or down by a heavy hand wheel and screw to regulate the depth of cut. The table proper is provided with a screw clamp for holding large work, and a small chuck, as shown at the base of the machine, for short work. The table may be tilted from side to side or from end to end in either direction, forming a universal adjustment for any required straight or angular gains, and it is supplied with an index so that it can be accurately adjusted to any degree angle without the use of a rule.

The attachment shown at the base of the machine is used to center a wagon axle by its skeins when cutting hound and reach gains.



SINGLE-HEAD AUTOMATIC GAINING MACHINE.

The weight of the machine complete is 2,500 pounds; total floor space occupied is 5 feet by 4 feet 6 inches.

A counter is furnished as follows: Shaft, 5 feet 6 inches long by $1\frac{5}{16}$ inches diameter; two No. 2 ball and socket adjustable drop hangers; driving pulley, 16 inches by 16 inches with split hub; pulley to release feed, $3\frac{1}{2}$ inches by 3 inches; one flange on shaft to guide feed belt; tight and loose pulleys, 10 inches by 6 inches; speed, 750 rotations per minute.

This machine is built by the Defiance Machine Works, Defiance, Ohio.

A Cheap Transverse Testing Machine and Some Results Obtained by It.

BY WILLIAM KENT, M. E.

The writer had occasion recently to make a study of the characteristics of aluminum hardened by the addition of small percentages of copper, tin, zinc and nickel. The method adopted was to cast bars of the various alloys one-quarter of an inch square in section, and 10 inches long, to measure their shrinkage and to test them by transverse strain. To save expense a very cheap but entirely satisfactory testing machine was designed, which is illustrated herewith.

A common spice scale of 62 pounds capacity was purchased, cost $7, and a large second-hand letter press was bought at a junk shop in Ann street, for $3. The uprights of the press were removed, and for them were substituted two longer 1-inch bolts, which were surrounded by gas pipe. A T-shaped casting was bolted to the upper platen of the press, and two L-shaped castings were bolted to the flat plate of the scale 8 inches apart as shown in the cut. The scale was set on the lower platen of the press in a diagonal position, so that the scale beam would clear the left upright of the press, and the two L-shaped castings were so placed as to cause their centers and that of the T-shaped casting to be in line with the two uprights. An arm of flat brass was bolted to the left upright, so that its outer extremity just cleared the outer end of the scale beam. On this arm a paper scale divided into sixteenths of an inch was attached, and a bent pointer attached to the end of the scale beam was adjusted so as to almost touch the paper scale.

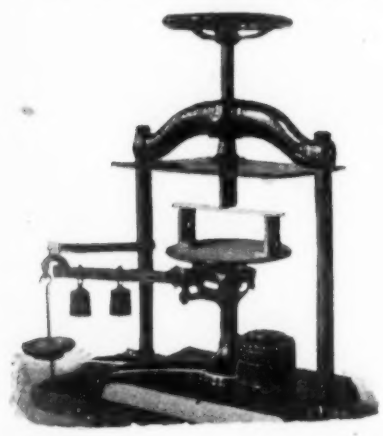
The screw of the letter press had four threads to the inch, and the hand-wheel rim was divided by scratching marks upon it into 25 spaces, so that each space represented a travel of the screw of a hundredth of an inch. The whole cost of the alterations was not over $2, so that the complete testing machine cost about $12.

The scale beam is double, one of the poise weights acting as a tare. In operation the test bar was properly centered on the two supports and was weighed by the tare poise, the poise being placed at such a point on the beam that the beam dropped below its middle position, so that the pointer was below the zero mark on the scale. The hand wheel was then carefully turned until the bottom of the T-shaped pressure piece just touched the test bar. A turn of a fraction of one of the marked spaces on the hand wheel would then bring the pointer up to the zero mark. The position of the wheel was then marked by a string tied around the rim at a point directly opposite the operator, and the point so marked was the zero of deflection.

The test being thus begun, and the tare weight being left in its position, the front poise was moved from 0 to the 2-pound mark. The beam at once moved downwards a trifle, and the hand wheel was

turned until the pointer on the beam was again opposite the zero mark on the paper scale. The amount the hand wheel had been turned, expressed in hundredths of an inch, was then recorded as the deflection corresponding to 2 pounds weight. The test was then continued in like manner, 2 or 4 pounds being added at a time, and the deflection recorded at each addition.

Before the elastic limit was reached the beam rested quietly at zero each time the load was applied, after the hand wheel had been turned, so as to bring the pointer to zero. After passing the elastic limit, however, the bar would show signs of flow, and in that case the reading of deflection was taken at the position of the hand wheel when the pointer first reached the zero mark. The beam would then slowly drop, and the hand wheel could be turned whatever additional distance was necessary to cause the pointer to remain at zero. Generally a turn equal to two or three hundredths of an inch was sufficient, but as the bar approached its ultimate resistance, especially if very ductile, so that it would bend through a deflection of 2 inches or more before breaking, the hand wheel might be turned through a complete turn or more without the beam showing any appreciable increase of resistance.



A Cheap Testing Machine.

The following table shows the results obtained in tests of bars of aluminum hardened by copper. Two bars of each alloy were cast, and the table contains the complete record of the bar of each pair which showed the highest strength; the strength of the duplicate bar being given at the bottom of the table. The record of the deflections of both bars of a pair was practically the same up to the breaking point of the weaker.

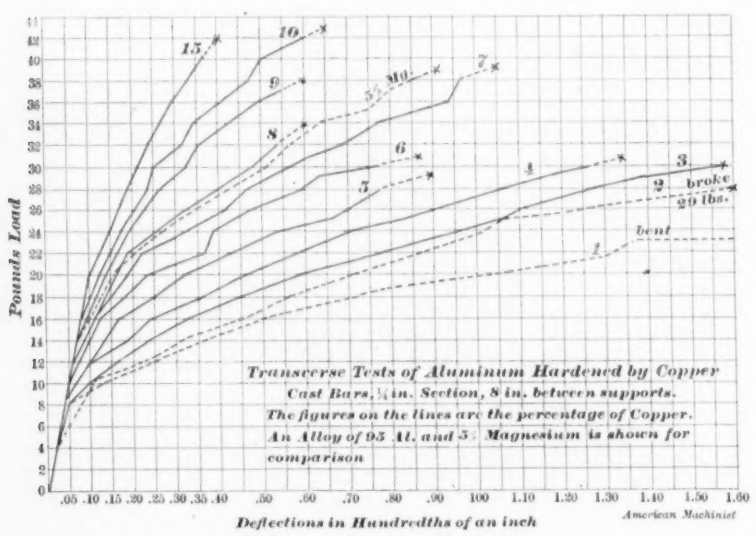
The modulus of rupture is calculated from the formula $R = \frac{3\,P\,l}{2\,b\,d^2}$, in which P is the breaking load, l the length, 8 inches, b the breadth, and d the depth, each taken at 0.256 inch.

The bars were all cast in sand, and were apparently sound. The fractures were all granular, and of a dull whitish gray color.

In testing some of the bars a peculiar irregularity in the deflections was frequently observed after the bar had passed its elastic limit. Thus in the bar containing 7 per cent. of copper, an increase of the load from 34 to 36 pounds produced an increase of deflection of .17 inch, while the next increase of load of 2 pounds produced an increase in deflection of only .02 inch. Also in the bar containing 10 per cent. of copper, while the increased deflection between 34 and 36 pounds was .06 inch, and between 36 and 38 pounds .07 inch, from 38 to 40 pounds it was only .03 inch. This phenomenon was more especially noticed in testing bars of aluminum alloyed with tin and with zinc. The writer has not noticed it in tests of any other alloys than those of aluminum. In some cases when 2 pounds additional load was placed on the beam it would drop slowly through such a range that the hand-wheel would have to be turned an amount equivalent to a deflection of 0.1 inch in order to bring the pointer to zero; then when the next 2 pounds was added the pointer would scarcely move at all; then 1 pound would be added and the beam would drop, showing another deflection of 0.1 inch or more. The plotted diagram of such a test instead of being a curve would be a series of steps. The writer would be pleased to learn if any other observer has noticed such a phenomenon with aluminum or any other alloys.

TRANSVERSE TESTS OF ALUMINUM-COPPER ALLOYS. CAST BARS ¼ INCH SQUARE IN SECTION, 8 INCHES BETWEEN SUPPORTS.

Bar No.	1	2	3	4	5	6	7	8	9	10	11
Per cent. of copper.. ..	1	2	3	4	5	6	7	8	9	10	15
Load, lbs.	DEFLECTION IN INCHES AND DECIMALS.										
4	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
8	.05	.07	.05	.04	.04	.04	.04	.04	.04	.04	04
10	.12	.10	.10	....	....	....	....	.06	.05	.05	..
12	.25	24	.16	.10	.08	.07	.06	.06	.06	.06	.06
14	.37	.31	.24	.18	....	..	..	.09	..	..	....
16	.52	.47	.33	.24	.16	.12	.11	.11	.09	.08	08
18	.72	.57	.46	.37	.25	.18	....	.15	.....	..	..
20	1.07	.72	.60	.46	.31	.23	.19	.17	.13	.12	.10
22	1.32	.87	.79	.58	.44	.36	.21	..	.....	....	...
23	1.37	....	....	....	....	....	....	....	....	....	....
24	bent	1.03	.96	.70	.54	.38	.32	.25	.19	.17	.15
25	....	1.06	1.06	.83	.67	....	....	..	.....	..	..
26	....	1.25	1.10	..	....	.47	.41	.32	.....	..	....
28	....	1.60	1.28	1.08	.78	.60	.46	.40	.26	.23	.19
29	....	broke	1.39	1.17	broke	.63	....	..	....	....	....
30	....	....	1.58	1.27	....	.78	.56	.48	.32	.25	.21
31	....	....	broke	broke	....	broke	..	....	....	..	..
32	....	....	....	....	....	....	.68	.53	.35	.31	.23
34	....	....	....	....	....	....	.77	broke	.42	34	.26
36	....	....	....	....	....	....	.94	....	.48	40	.29
38	....	....	....	....	....	....	.96	....	.58	.47	.33
39	....	....	....	....	....	....	broke	....	broke at 38 lbs.	....	..
40	.	....	....	....	....	....	....	....	.. ..	.50	.36
42	....	....	....	....	....	.	....	....	.....	.60	broke
43	....	....	....	....	....	....	....	..	....	broke	....
Duplicate piece broke at, lbs.....	24	29	28	25	26	27	37	32	36	36	38
Average of both pieces...	24	29	29 5	28 5	27.5	29	38	33	37	40	40
Modulus of rupture.....	17,160	20,735	21,048	20,328	19,603	20,735	27,170	23,595	26,455	28,600	28,600



A few alloys of aluminum and magnesium were tested. The one that gave the best result is shown on the diagram. It contained 5 per cent. of magnesium. As seen by the diagram, it was very similar to the alloy with 7 per cent. of copper, breaking at the same load, 59 pounds, but the duplicate bar broke at only 28 pounds after a deflection of 0.57 inch. Duplicate bars containing 15 per cent. of magnesium, broke at 32 and 36 pounds, and bars containing 20 per cent. of magnesium, broke at 18 and 19 pounds.

A great number of other alloys of aluminum were made and tested, including alloys with tin, zinc, nickel, German silver and various combinations of these with each other and with copper. A few good alloys were found among many worthless ones, the most promising being combinations of aluminum with copper and nickel.

The testing machine, as already stated, has proven entirely satisfactory. The only improvement in it that the writer can suggest is to use a scale of greater capacity than 62 pounds, so as to be able to test bars of greater strength, such as aluminum bronzes. What is known as the Union scale, a small platform scale of the capacity of 240 pounds, would be suitable for the purpose.

Mechanism of the Pocket Watch.—II.

By H. E. Duncan.

I will return for a moment to the balance and hairspring, which I called the automatic governor of this spring motor

Without touching upon the constant, and often violent and sudden, changes in the position of the watch, I will consider the effects of temperature, which is constantly varying and often quickly and between wide limits. The structure of the hairspring of the watch, presenting as it does so much surface, in proportion to its total mass, is such as to render it particularly sensitive to thermic influences. It is a well-known law of nature that all metals expand under the influence of heat, and that springs lose something of their elasticity with a rise in temperature.

Applying these laws it is found that the balance will increase in diameter and the hairspring lose some of its elasticity by heat. From these two causes the watch will lose by a rise in temperature, while the opposite effect will be produced by a fall in temperature. The effect of temperature on balance and spring is corrected by what is called the compensating balance, invented about the year 1782. This is so constructed that the same heat which weakens the elastic force of the hairspring, serves at the same time to reduce the diameter of the balance, so as to exactly adapt it to the force which the weakened spring is capable of exerting. This automatic compensation is obtained by constructing the balance rim of two metals, having widely differing ratios of expansion. In the ordinary watch the two metals employed are brass and steel. The inner portion of the rim being of steel, with an encircling band of brass, and the two metals being firmly united by fusion, the action of this form of a balance will readily be understood by a few words of explanation in connection with the diagrams on the screen.

Fig. 12 represents two strips of metal, brass and steel, of equal length at normal temperature. Under the influence of heat or cold these strips will expand or contract in about the ratio indicated by the dotted lines. Now if the brass were firmly united to the steel as in Fig. 13, and their respective thicknesses be in the ratio of three of brass to two of steel—then the brass would not be free to expand or contract, being held by its union with the less expansive steel, and the result would be that when heated the bar would curve as in Fig. 14, while when cooled it would curve in the form shown in Fig. 15.

The next two figures will show how this law of expansion is utilized in the construction of compensating balances.

The first of these, Fig. 16, shows the balance with its rim of brass and steel at normal temperature; the next, Fig. 17, shows the form it assumes when heated. You will observe that the rim of the balance has been severed at two opposite points and near the arms, leaving the cut ends free to move out or in by changes of temperature. In the next drawing, Fig. 18, you will notice that the balance has received an addition in the shape of screws with large heads.

Fig. 12.

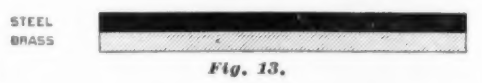


Fig. 13.

Fig. 14.

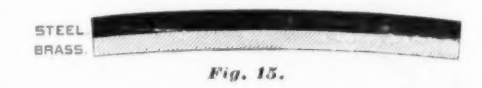


Fig. 15.

These have a double use. First, to give the balance the exact weight desired, so that in conjunction with a proper hairspring, it shall make the exact number of vibrations per hour required, which in most modern watches is 18,000. In making this number of vibrations the rim of an ordinary balance will travel 3,479 feet, or nearly 18 miles per day. Now, if for any reason the balance were to omit only 10 of these vibrations in an hour, the watch would have lost two seconds of time, or 48 seconds per day, over three-fourths of a minute. The addition of

Fig. 16.

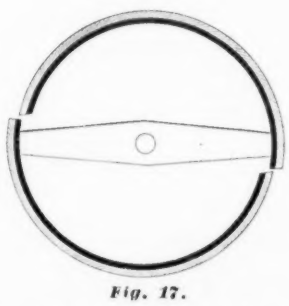


Fig. 17.

one of these little screws to each side of the balance will reduce the number of its vibrations, amounting, in some conditions, to as much as 98 seconds per hour, or 39 minutes per day.

I will now make plain to you the second use of these little screws. In this view we have the screws numbered, Fig. 19, and you will observe that between the screws

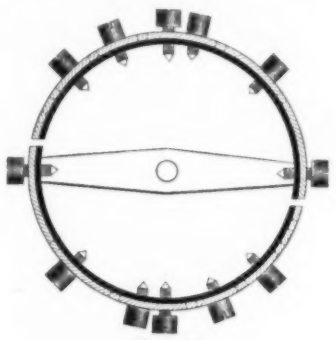


Fig. 18.

are holes, which are adapted to receive screws, and these holes are also numbered. A careful and accurate trial might show that at a normal temperature (about 70° Fahr.), this balance would have the correct size to give its required number of vibrations, but by subjecting the watch to an increase of 25 degrees in temperature, it might be found to lose as much as seven seconds per hour, or 35 vibrations. This fact will indicate that when in heat the balance is too large; or, more properly stated, the effective weight is not properly located, being too far from the axis. In this case we would move screw No. 3 to position marked No. 12, thus giving an added weight to that part of the rim,. where the effect of the heat would cause it to curl in toward the axis and so allow more rapid vibrations.

Manipulations of this sort are always required in adjusting watches to temperature.

I now show on the screen the motion of a watch balance in heat that you may note this action. . . .

As early as the year 1837 European horologists endeavored to account for unexpected changes of rate in ship chronometers on the theory that their balances were influenced by magnetism due to the magnetic polarity of the earth.

Experimental balances were made of many non-magnetic metals that would not be influenced by such lines of force. By these experiments it was proved that the earth's

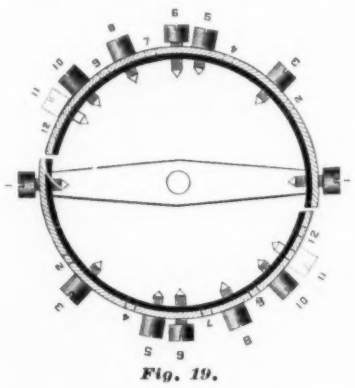


Fig. 19.

magnetism was not the prime cause of the error of rate that they were seeking to remove.

At the present time the magnetization of pocket watches by induction from the many sources of electric current now so commonly in use, makes the question of furnishing a non-magnetizable watch one of the prominent problems of modern watch manufacture.

A pocket watch will show but little if any change of rate that can be traced directly to the influence of magnetism due to the earth's polarity, but by placing the watch within the influence of an intense artificial magnetic field its rate will be seriously affected. Magnetic fields of an intensity sufficient to stop the watch are to be found on every hand, and if the wearer knowingly or otherwise ventures into the lines of force, the watch will be subject to the well-known laws of magnetic induction, and will instantly adapt itself to them.

There are two well-known laws of magnetism that apply to magnetized watches.

The first is that any so-called magnetic metal, placed in the field of a magnet, will itself become a magnet, and will retain this magnetism in a more or less marked degree when removed from the field. Steel is a marked example of such metals.

The second law is that similar magnetic poles will repel, and dissimilar poles will attract each other.

By applying these laws we will have a full understanding of the effect of magnetism on a pocket watch of the usual construction, and an explanation of its loss of value as a timekeeper.

A watch in the field of a magnet, strong enough to stop it, will usually, when removed, at once commence running again, but its time-keeping qualities will have been ruined. It is true that it can be demagnetized, but this, while a relief, is no permanent cure, and the watch will magnetize again as before.

On the screen we have the shadow of a magnetized piece of steel called a magnetic needle.

You will note that when the horseshoe magnet approaches it, it assumes a condition of sympathy with the magnet's polarity, but by reversing the magnet, the needle at once

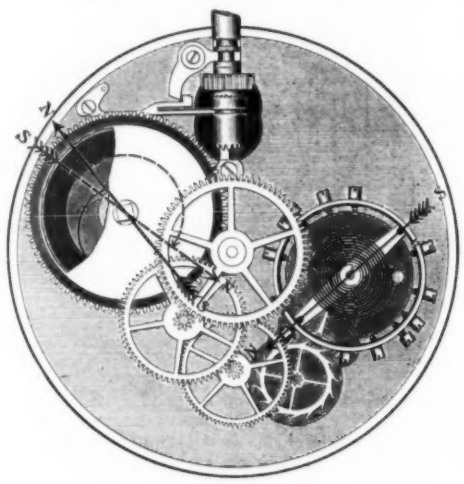


Fig. 20.

reverses, so as to conform to the previous conditions of attraction and repulsion of magnetic poles.

The horseshoe magnet is the stronger and the needle responds to its polarity, as it is free to revolve. If it were not, the horseshoe magnet would reverse the magnetism of the needle. . . .

It is safe to say that in the majority of cases, when watches have been found to be magnetized, it has happened at some time unknown to the wearer, who had wandered into the field of a powerful motor or dynamo. When a watch stops in a magnetic field the magnetism is strong enough to hold the balance.

A magnetized watch has a very irregular rate. A marked gain or a loss of time will usually be followed by the opposite condition, these alterations varying in quantity at different hours of the day. The more marked the polarity of the watch, the greater will this variation become. In the pocket watch, we have two pieces of steel in particular that absorb and retain magnetism, when brought into the field of a magnet. I allude to the mainspring and balance (see Fig. 9). The former is the greater quantity, owing to its mass and hardness. The spring, as you will recall, was a long ribbon of steel,

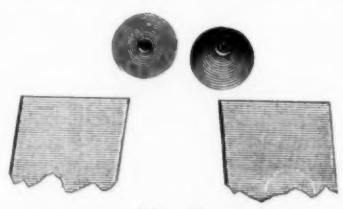
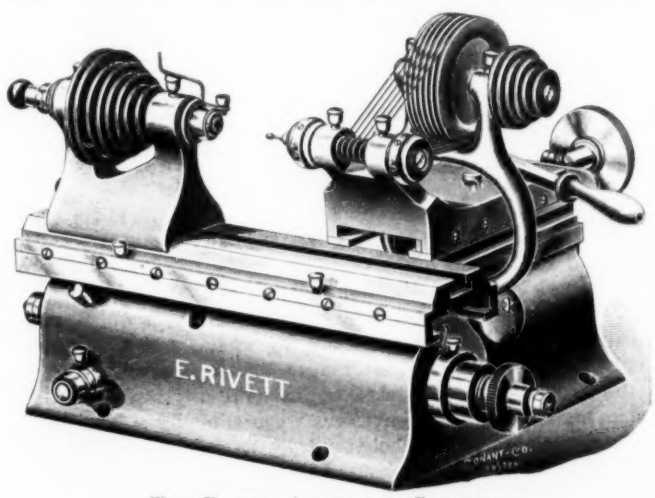


Fig. 21.

in a cup or barrel, that when fully wound was in a small coil, in the center of the barrel, wrapped around the arbor, and when run down was in much larger coils, that had expanded until they had filled the barrel. We will have here, at the extremes of fully-wound and run-down, two laminated rings of magnetized steel that will show polarity, but the direction of this polarity will change as the spring passes from the condition of fully-wound to that of run-down.

Here we have a magnet that changes its polarity through the whole period that the spring is passing through its changes in driving the watch. The other piece or part of the watch that I have mentioned, that is in particular important in the study of the problem, is the balance. You will recall that its arms and part of its rim are of steel. They will consequently become polarized, but this polarity, unlike that of the mainspring remains a *constant factor*. In the case of the coiled mainspring, its polarity appears to take nothing from the stored-up energy of the spring, but in the balance we have a different condition. We have done all that could be done to remove friction, or make it constant, and to eliminate the factor of change of rate by changes of temperature, only to meet in our polarized balance a new factor, due to one of the laws of magnetism that I have stated. Its poles will be attracted, or repelled, by other magnetic polarity (near it). When the balance is in place in the watch and free from any influence of the train, its spring should return to the same place of rest or quiescent point. This place of rest is one in which its spring is free from tension; but the moment the balance becomes polarized, it immediately tries to place itself in sympathy with this new condition, and disregards the previous relations with its spring in regard to the place of rest. There is at once established in the spring a state of stress to oppose this. The spring no longer is natural in its action. Were all these disturbing elements constant factors, the result would be a constant error, Fig. 20.

But this is not the case. The polarized mainspring is constantly revolving and presenting its ever changing magnetic poles to those of the balance. At times these are in sympathy with its own polarity; again they are exactly opposite. In one case the balance will make its excursions too quickly, in the other not quick enough. In one case the watch gains, in the other it loses. I have on the screen a magnetized balance and spring in the position they occupy when in the watch. A test by a small compass needle shows them to be polarized.



THE RIVETT AUTOMATIC GRINDER.

Vibrate the balance and it returns to its former place which is in sympathy with the polarity of the steel spring in the barrel. We revolve the barrel a little and the polarity changes and the position of the balance responds to the change of polarity presented by the barrel. . . .

The hairspring comes under these laws, but being less in mass than the balance, its polarity is not such an important factor.

But the slide on the screen shows a balance of non-magnetic metals with the usual steel hairspring, and you will see it is a little influenced by the polarity of the mainspring.

I have on the screen two watch hairsprings, Fig. 21, one of non-magnetic metal, the other of usual metal, steel. The magnet serves to distinguish them. . . .

A non-magnetic watch is one in which all the governing parts are of non-magnetic metal. When these conditions are present, magnetism will not affect the time-keeping qualities of such watches. . . .

I show you on the screen finally the action of the magnet on two watches, one of the usual construction, the other with all its governing parts of metal such as is used in the Waltham non-magnetic watch. . . .

The Rivett Automatic Grinder.

We present herewith an engraving of a grinding machine which was designed especially for grinding the hole in the hardened draw chucks used in the "Rivett" lathe.

As the holes in these chucks include sizes as small as .013 inch, and the lap with which they are ground must be somewhat smaller, it is readily seen that the attainment of the speed required for efficient grinding is one of the chief problems; and the quarter-inch spindle in this machine regularly runs at 60,000 to 75,000 revolutions per minute, and has attained 100,000 revolutions. At this speed it is found that the spindle is much more rigid than at the lower speeds usually employed.

It will be noticed that six small round belts are employed to drive the spindle, and that the larger pulley is so mounted as to be readily moved towards or from the spindle to adjust the belt tension.

The other features of the machine will be readily understood. It will be noticed that the platen is fitted to receive the regular lathe head, and this platen is moved automatically upon its slide during the grinding. Four of these machines are in use in the shops of the Faneuil Watch Tool Co., Boston, where they were built—three of them for grinding chucks and the fourth for grinding the taper hole in tail stock spindles, and it is of course evident that they are adapted for any small, light and fine grinding.

The Humble Grate Bar.

BY L. C. JEWETT.

Of all patterns that come to the hands of a molder, there is none he has so little pride in making as the humble, ofttimes difficult, grate bar, and there are few castings where skill can be used to more advantage. Reference is made to the ordinary double bar, with from ¼ inch, ½ inch to ¾ inch openings between the bars. These are called "cluster" bars (see sketch). The average molder thinks it humiliating to work on grate bars, and he expresses himself in this manner, "That is boy's work." "The chump in the corner can make 'em—he is built that way. I—I am of finer clay," etc.

A kind-hearted molder observed the apprentice boy in tears one morning, and upon inquiry, was told that the manager, seeing that the boy had lost half the grate bars cast the day before, had threatened his discharge if he lost any in that day's cast. "Well, my boy, you come right here and see me put up a flask or two—I think we can save your job," said the kind-hearted molder. Instructions were then and there given the boy both "theoretical and practical," and the tears dried up. The kind-hearted molder returned to his work with a heart lightened by a kind deed done that brightened the rest of that day.

The next morning the manager came to inspect the previous day's cast. There were two flasks of these grates that were conspicuous by their worthlessness, except for scrap. "You remember what I told you," said the manager. "Yes, sir," boldly replied the boy, "but those that are not good

were made by the kind-hearted molder over there; the bars I made are all good, sir," as he smiled the smile of a winner. This set the kind-hearted molder thinking why so large a percentage of grates were lost, and after investigating the average treatment a grate gets from the average molder (and they are too frequently selected to make them), the following methods were followed with gratifying results. But first it may be well to describe the way the average molder goes about making a cluster grate.

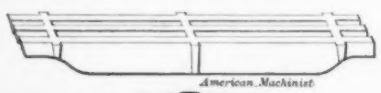
After placing the pattern in the nowel of flask, sand is riddled in a heap near by, and the average molder then proceeds to throw it into the spaces between the bars by handfuls—the stronger his arm the greater the force. This is a very uncertain way to fill the spaces between the bars, as it will not be uniform in density, and being wedged in tight it has a tendency to spring the bars, and when the pattern is to be drawn it is liable and frequently does start up sections of the thin green sand core. When cope is put on and clamped up it presses a little harder on that disturbed section and crushes it down, the liquid iron gets in the crack, bursts that core; result, bad grate. The average molder will throw sand in harder the next day, *so it won't crush.*

Another dangerous practice is to ram copes for grate bars too hard. This depresses the joint between the bars, and when the careless swab or sponge is drawn over pattern joint, *et al*, the water forms miniature lakes in those depressions, which are wet unto mud. When the liquid iron meets this wet sand, it simply kicks and either bursts the core or leaves a shelly place in the bars. The one thing very noticeable about all this is the immaculate innocence of the molder. The better and quicker way is to put the sand (after being carefully tempered, bordering on dryness) into a No. 6 or 8 sieve, and while sifting the sand onto patterns, hold the sieve five feet or so higher than the pattern is. Let gravitation do the packing—it will do it, and do it so even that every part of sand core will be of the same density, and unless the bar is over four inches deep, it will withstand the iron, and if deeper than four inches just run the fingers through and over the spaces to harden a little, but do not throw in the sand, no matter how deep the bar.

The nowel can now be rammed good and firm outside of the patterns, and butt ram good and tight. See that bottom boards are stiff and well ribbed on, that when mold is clamped the board does not yield, and push up the mold, and crush the thin cores against the cope. The cope for a flask of grates should be in fair condition for good bars, so that it can be softly rammed to avoid depressing the sand joint between the bars before alluded to. Do not use too much water to swab patterns with. To draw pattern, start it up gently, one end at a time (after rapping endwise) until pattern is free, then lift it out evenly. It will draw better, and there will be less need of consulting the neighbor to get his opinion as to possibility of cores standing the iron, and five or ten minutes of time used up hunting for a broken piece of looking-glass to see if the flour that is usually thrown in has really struck bottom or not—there will be less call for all these ceremonies.

And many a bleed of the innocent novice's heart sting of regret at rebuff to the honest "done my best, sir," and also the swagger of the "don't care fellow" will be missed if the above advice is followed.

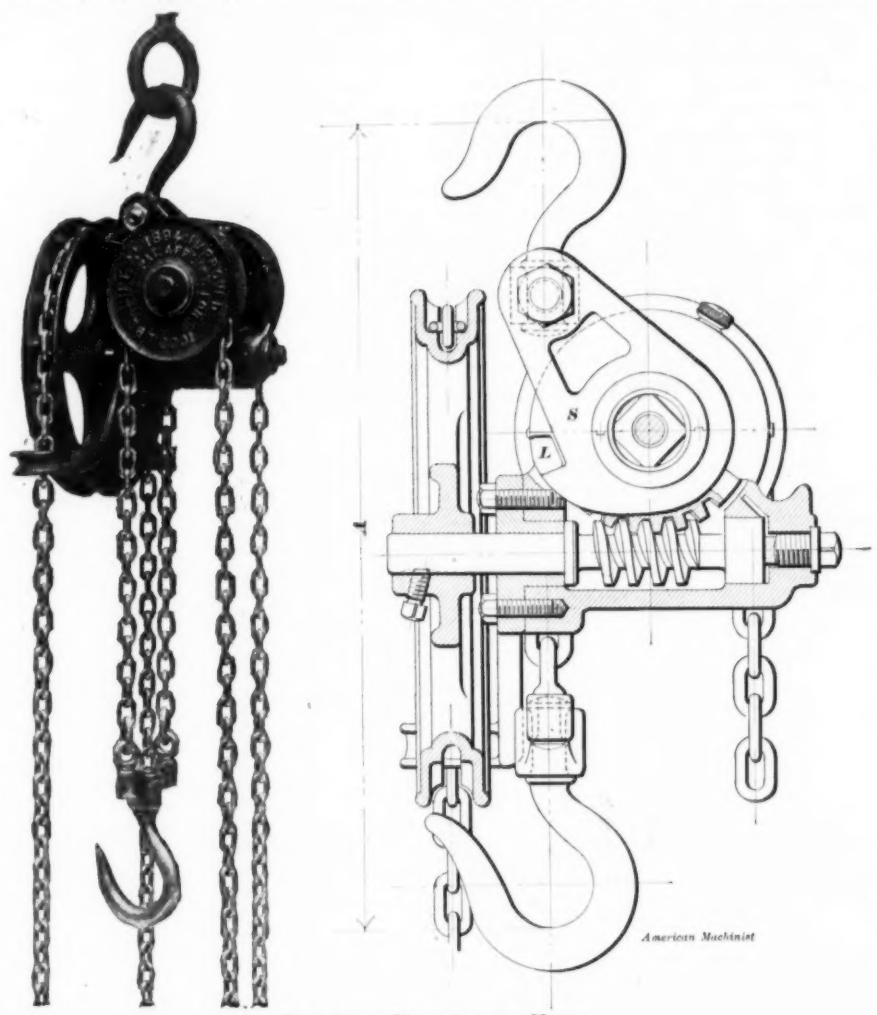
The venting is required, but less will suffice than when sand is thrown in. Another and often neglected matter should be observed, that is, the flask should be level to insure the liquid iron raising up evenly around the thin and tender cores.



William O. Webber has severed his connection with Henry R. Worthington, and has opened an office as consulting engineer in the Mason Building, Boston, Mass. He will pay particular attention to engine and boiler economy, measurement of power, and hydraulic engineering.

The New Harrington Hoist.

The screw hoist which for years has been made by Edwin Harrington, Son & Co., of Philadelphia, is perhaps one of the best known shop appliances in this country, as it has been extensively used in almost all kinds of industrial establishments where objects too heavy to be readily lifted by sheer force of muscle are handled.



THE NEW HARRINGTON HOIST.

For a year or more past this hoist, with the methods of manufacture pertaining to it, have been undergoing a radical change; we have already shown some of the processes employed in its manufacture and expect to give more of them as opportunity offers; our present subject being the reconstructed hoist itself, of which we give a perspective and a sectional view.

Those who are familiar with the machine will perceive that the new form retains practically all the distinctive features of the old, *i. e.*, the machine consists essentially of a frame or casing which contains a worm and wheel, while outside the casing attached to the worm shaft is the hand-chain sheave, and to the worm-wheel shaft two chain sheaves, one on each side, over which passes the load-carrying chain, which is double and so arranged that it is readily lifted off the sheaves and as readily replaced. This is convenient when climbing a ladder with the hoist, and, by making it easy to adjust the chain to the required length, saves some winding.

Where the two ends of the load chain join the yoke above the hook they are attached to swivels which make it impossible for the chain to be strained by twisting, no matter how often the hook may be passed over between the chains in handling the hoist. The other, or looped end of the chain, hangs loose, or, when in the way, can be hung over the horn formed for that purpose above the screw which takes the thrust of the worm.

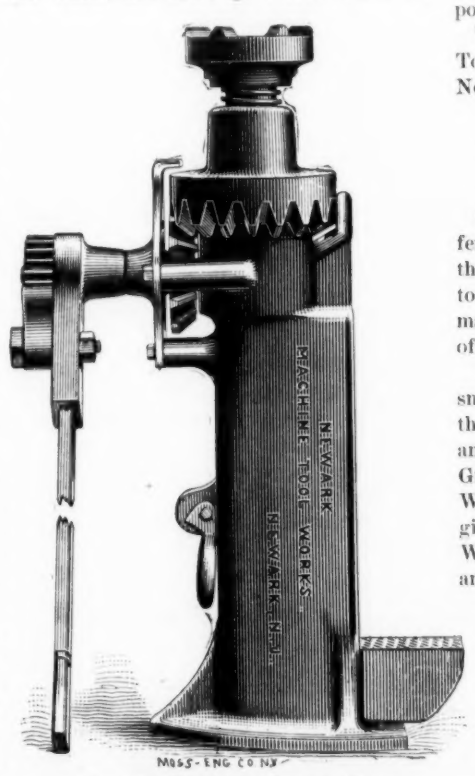
Experience shows that users of hoists differ as to the manner in which they desire them to operate. Some require them to be so arranged that when a load is descending it must be constantly assisted down by the hand chain; while others require that, when started down, it shall continue to run down by its own weight; and to provide for both these the thrust of the worm shaft is carried, as shown by the sectional view, upon the screw at the right, a composition antifriction washer being interposed. In this position of the thrust screw the load will run down itself, while if the screw is simply backed out a few turns the enlarged end of the worm shaft comes to a bearing and the moment of friction then becomes sufficient to prevent running down; the change from one condition to the other being very easily and quickly made. It will be noticed that when in the position shown by the sectional view the screw is seated upon the shoulder at its head, which defines its proper position and prevents its being loosened by the motion of the worm shaft.

Special pains have been taken to get an efficient smooth working and durable worm and wheel, and thorough lubrication is secured by making the case oil tight; the joint between the two parts of the case being horizontal and at the worm-wheel axis; leaving the lower portion of the case solid metal.

The shaft upon which the two load-bearing chain sheaves are fitted is solid with the worm wheel, and those parts of it which extend outside the case at each side are squared as indicated, a square hole being formed in the sheaves to fit it. It is this square hole which is formed by the remarkable broaching operation illustrated and described in our issue of September 13, 1894. The sheaves are an easy fit on the squared shaft and are secured in place by a bolt which passes freely through the latter from end to end and has washers covering the ends of the shaft. Thus by removing one nut both these sheaves readily come off.

The stress imposed by the load is not carried through the case, but is borne by two suspension links (*S*) which are fastened to a yoke above and fit over circular projections, one at each side of the case, concentric with the worm-wheel axis; the proper vertical position of the hand-chain sheave being maintained by the lugs *L* which are formed upon the case.

In choice of material and in general arrangement and proportion of parts the designers have been guided by their extended experience with such machines, and we know from a personal inspection of the processes employed that thorough interchangeability and excellent work is secured throughout. Hoists of four sizes, to lift 500, 1,000, 2,000 and 3,000 pounds, are now made in this style and other sizes to lift up to 20,000 pounds will follow; such proportions of gearing and chain sheaves being used in the various sizes as are necessary to get the most efficient service from them.



ROLLER BEARING SCREW JACK.

Roller Bearing Screw Jack.

We here illustrate a roller bearing screw jack, especially designed for machine shop use where a positive holding jack is often a great convenience by doing away with the necessity of blocking up at each stage to prevent accidental slacking back.

The bevel gear is driven by a heavy ratchet, the extension lever of which can be removed to allow a full turn to be made for rapid lowering. The load, which can be raised by either the head or toe of the jack, is carried by hardened steel roller bearings, which reduce the friction to a minimum.

The jack is made entirely of either steel or best air furnace malleable iron, and all parts are designed to be practically unbreakable.

Two regular sizes are built, both of which stand 24 inches high, and lift 12 inches; the weights being 75 pounds and 100 pounds.

This jack is made by the Newark Machine Tool Works, of 212 and 218 Passaic avenue, Newark, N. J.

American Machinery and Tools in England.

Charles Churchill & Co., of London, referring to the recently published letters on the state of trade in machinery lines, write to the effect that their sales of American machinery and tools in 1894 exceeded those of 1893 by 20 per cent.

"There has been a good improvement in small tools," they write, "but the bulk of the increase has been in heavy machinery, and this at a time when the general trade in Great Britain has been extremely quiet. We think this will show the special favor given to American machinery at such times. We have at the present time many inquiries and orders in hand, and we think all the tendencies are to a still larger increase in 1895."

They give us a summary of some of the principal sales for the year, and we notice amongst them such things as a 10-foot boring mill, and large radial drills, 104 lathes of various makes, large numbers of grinders of various kinds, 242 micrometer calipers, 1,026 milling cutters, 1,662 lathe and drill chucks, 89 gas furnaces, 1,525 wood split pulleys, 14,500 feet of belting, besides many other things too numerous to specify, all of American manufacture.

Though this firm does a large business it does not, of course, handle all the American machinery and tools sold in England.

Manhole and Nozzle Forming Machine.

We here illustrate a machine for forming manholes and nozzles in plate metal.

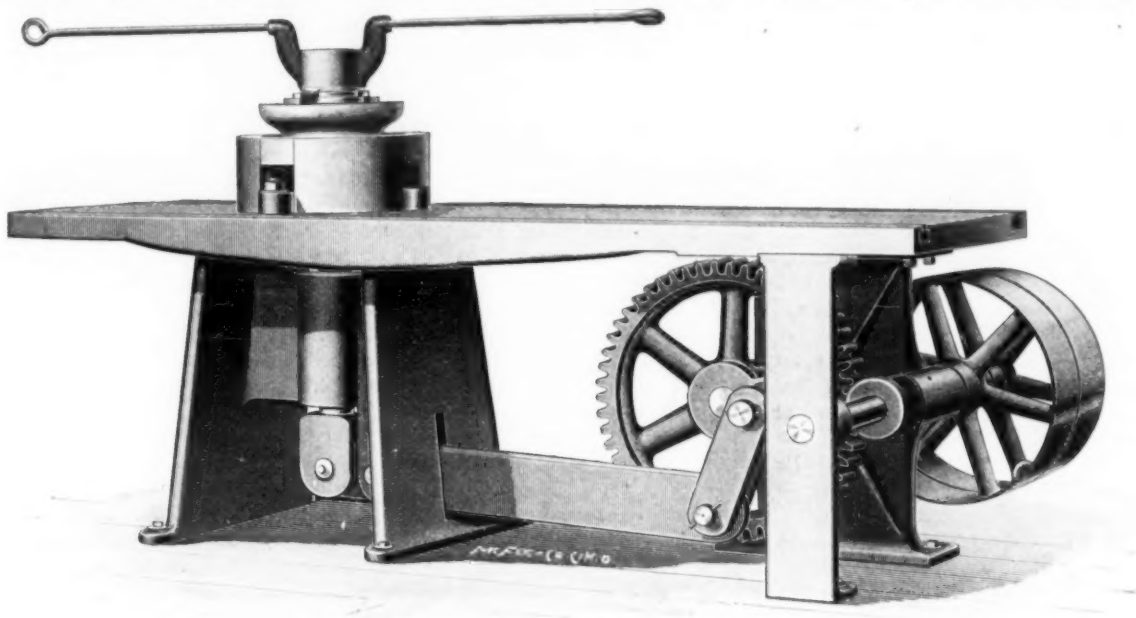
The former, which is driven by belt power, is capable of working out manholes up to 11″x16″, and nozzles up to 18″ diameter.

The table is 24″ wide by 78″ long, mounted on a heavy base 30″x30″x24″ high, making the table top 27″ above the floor.

The base has a central bearing 12″ long, bored to receive the 3″ steel ram, and all levers, links, pins, etc., are of steel.

The belted pulleys are 18″ diameter, and the driving shaft transmits power by means of a heavy shrouded pinion.

This machine is manufactured by the Liberty Manufacturing Co., of Liberty, Ind.



MANHOLE AND NOZZLE FORMING MACHINE.

Shop Tools and Jigs—A "Jumper"—Heading Small Bolts—Hiding Steel—A Blower Kink—Lathe Chucks—Grinding Screw-cutting Dies—Tool-room Dentistry—Some Tool-room "Accommodations."

BY JAMES F. HOBART.

During the past 17 years the AMERICAN MACHINIST has placed before its readers several thousand shop kinks, which, it is safe to say, have increased by many hundreds of thousands of dollars, the wages earned by its readers, and the work will not stop here, for thousands of good short cuts, kinks and dodges are yet to be presented to its readers. Every machinist in this glorious country has some particular method of doing some job that might help his brother machinist earn an extra dollar were he acquainted with the method or kink in question.

The blacksmith without a helper is supposed to be as helpless (no pun intended) as the proverbial ship without a rudder, but the machinist frequently has to do his own forging, and do it without a helper, too. Probably it was a machinist who was "playing a lone hand" in this manner, who built the first "oliver," to do his striking. The oliver has proved a valuable machine for certain kinds of work, the chain-maker particularly having almost universally adopted it in some form, and using it for giving the finishing touch to the link.

The "jumper" shown by Fig. 1 is a cross between a jeweler's punch or swage, and the old "smith's oliver." The tool is made to fit into the hardy hole of the anvil. The shank that goes into the hardy hole may be made long enough to reach down through the anvil *e*, and a cotter may be put through the shank when a long job is to be done with the tool. The base *a* holds the bottom die *d* which is made tapering at the bottom, as shown at *h*. The punch *c* slides easily through the guide *b*, which is accurately located so punch *c* will always match die *d*.

In rounding up small work this "jumper" is a valuable tool. It is of no use for anything larger than three-quarters of an inch, for the punch and die are made of seven-eighths steel in the tool illustrated. Larger tools could be made to stand on the saw, or in a hole in the base plate. Several forms of punches and dies may be made to fit the same tool. In the engraving *c d* is for three-eighths round iron. The tool shown at *f f* is for five-eighths round work, and punch and die *g g* is for square work. In making assorted punches and dies it is necessary that they be all tapered exactly alike at *h*. Upon that point depends to a great extent the lasting quality of the tool.

Fig. 2 shows the manner of making a "jumper." The piece of plain flat bar iron is bent up as shown by *i m* and made to fit the shank *k* and standard *l*, both of which are welded into *i m*. Before shank *k* is welded in it should be drilled, as seen at *n*, the drill going to the depth shown at *S*. This hole is afterwards swaged out to the shape *t*, seen at *o*. The swaging is done by heating the tool after welding up, and then while hot driving the punch *p* down into hole *S* in piece *n*.

After punch *p* has been used for swaging the shank the former (made of fine cast steel) may be easily made into a punch and die by drilling hole *r* in piece *q*, and then sawing off at the dotted line. The guide *k* is formed by bending up a piece of flat bar iron and is fastened by welding, riveting or brazing. A combination of the two makes a good job, a couple of rivets being put through *k* and *j*, then braze together for keeps.

Fig. 1

American Machinist

Fig. 3

American Machinist

Another very handy tool for the smith is shown by Fig. 3. This tool is for heading small bolts, etc., but may be used for a variety of purposes, from acting as a pipe vise to a nail-making machine. The engravings show so plainly the manner of making, that little description is necessary, save to state that the device is made of steel and is used between the jaws of a vise, little if any fitting being necessary to use it in any vise. In use the rod is slipped through the jaws of the tool after having been heated. A turn of the vise clamps the rod, and the head can be made and the upsetting done at the same time. In using some heading tools, particularly on small jobs, it is frequently necessary to screw the rods into a vise and upset them before putting them into the heading tool. This tool and the "jumper" were both made by a cousin of the writer, up in the Granite State, Mr. Nathaniel Hobart, of Brookline, N. H. He made the heading tool for making floor nails, a species of clout nails about two inches long, one-fourth inch in diameter, with a round, thin head three-fourths inch in diameter. These nails are used for fastening boiler iron plates to wooden floors where there is a good deal of travel and pushing of trucks, particularly in the rag engine room of a paper-mill.

Fig. 4

American Machinist

Fig. 2

American Machinist

SHOP TOOLS.

I noticed in the repair shop of that same paper-mill an ingenious rig whereby the blower which supplied the forge could be placed outside of the shop where the air was fresh, and chiefly where the noise of the blower was less annoying. The blower was located convenient to the shafting overhead, and a shipper rigged to guide the belt at will between the tight and loose pulleys. Instead of the regulation shipper handle a very small wire rope was attached to either end of the shipper bar and carried over half a dozen pulleys to the forge, where they hung from the ceiling, each attached to a 20-pound sash weight. A small casting on each rope, similar to those used on elevator starting cables, offered a good hand-hold when shipping the belt. The cables went through holes in a board shelf placed just above the sash weights, thus keeping them from swaying around when pulled. A slide in the blower pipe close to the handles completed the arrangement, and the air blast was under perfect control.

Another trick played in that shop was the secreting of tools and material which it was not desirable everybody who came along should have the handling of. It is, as some of my brother machinists well know, of no use to lock up things in a paper-mill. Only a burglar proof safe can keep a machine tender out when he covets a chisel, wrench or other tool nicely locked up from him, and I have known of cases where it was strongly suspected that even steel safes failed to keep the machine tender out. The *dernier ressort* for a paper-mill machinist then is to hide the objects to be kept. A particularly fine piece of steel three-fourths inch in diameter by three feet long, was hidden by placing it close up under the window stool and driving a nail underneath it to hold it there.

Another piece of bar steel six feet long was passed up the capacious chimney and stood on a staple driven into the mortar between two bricks. A special pipe tap found a berth in one corner of the coal box on the forge. A vertical overhead drill stood in the shop and work was laid on a block cut from an old wooden water-wheel shaft, octagon in section and 32 inches through. A bit of board was nailed on either edge of the bottom to make the block stand firmly on the floor, and all the best drills were hidden in the cavity thus left between block and floor.

But the *ne plus ultra* of secretive apparatus was a "contraption" built up for a combined surface plate and arbor-driving rig. It consisted of a short piece of 24-inch water pipe set on end and a three-inch cast-iron slab about two feet square laid on top of the pipe. A hole about eight inches in diameter had been made in the casting, and this hole, bushed down by a collection of old collars, pipe flanges and "holes" of various sizes, formed the base of all arbor-driving rigups. But inside of that piece of 24-inch cast-iron pipe there was kept all *special* plunder, and I have known a peck of apples, a 15-inch hand of tobacco, and even a can of *spiritu fermenti* to remain there undisturbed and undiscovered until consumed.

The Boston & Albany Railroad has its lo-

comotive repair shops on Broadway extension, Boston, Mass., and Mr. W. F. Hamlin, the "tool-room god," and an old reader of the AMERICAN MACHINIST, has many a kink and contrivance for lightening his daily labor and improving the quality thereof. On the B. & A. system certain men keep the emergency cases, and have been obliged to take degrees in "first aid to the injured," as well as in masonry. Mr. Hamlin was chosen as the "emergency" man of the shop, partly because of his central and permanent position, but probably because of his well-known faculty so often displayed in surgery as "shop eye-doctor," but the emergency case is in the tool-room, and Mr. H. does his work well, as many a suffering man could testify.

Recently Mr. H. added a new side line—that of dentistry. A hand came to the tool-room window, and nothing would answer but the offending molar must be plucked out. After some parleying the "patient" was wedged in between the tool-room lathe—a Sellers tool-grinding machine—and the elbow and knee of the amateur dentist. A "hitch" was made, and with a mighty twist and a mightier groan the tooth was yanked out *with a pair of gas pliers*. Mr. Hamlin has many requests to swap teeth for brass checks, but he got out of it forever, and worked a glorious revenge upon a mortal "professional enemy" at the same time. It was thus: He made a present of a pair of dentists' forceps to the boss blacksmith, and then sent all toothache cases to him.

A very handy contrivance made by Mr. Hamlin is shown by Fig. 4. It is a chuck

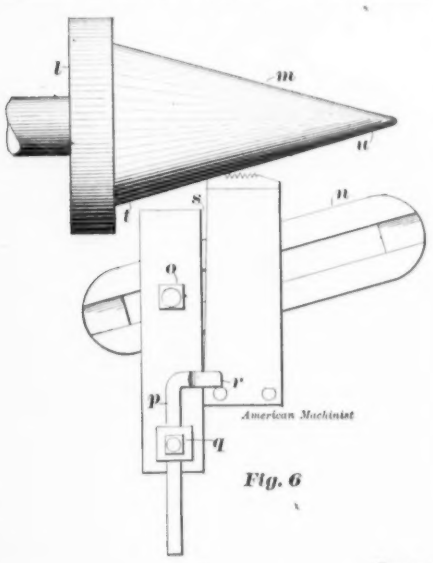


Fig. 6

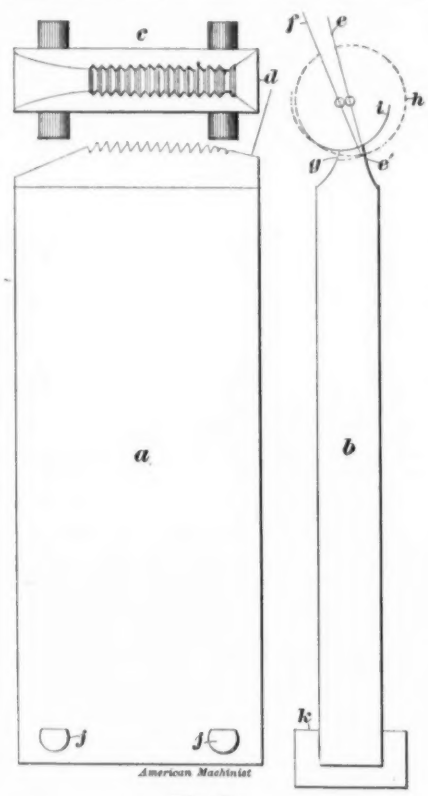


Fig. 5

SHOP TOOLS.

which fits the tool-room lathe at *a* and tools *c* and *d* at *b*. The jig *d h* is for holding and driving twist drills while turning the shanks down to fit the shop tools. As may be seen at *h*, the lower end of *d* is marked for three sizes of drills as shown, $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{5}{8}$ respectively. To turn a drill, chuck *a* is put on the lathe spindle, *d* inserted in *b*, and the business end of a drill inserted at *d*. The cutting lips of the drill engage one of the "steps" in the steel shell, and being pressed up a little by the tail spindle which is brought up against the shank end of the drill, enough driving power is gained by contact with the drill cutting lips to enable the shank to be turned up in short order.

The jig *c g* is for making the short balls shown at *i*, *j*, *k*, *l* and *m*. The last three are of great value for use on the vertical drill press when certain kinds of close work must be done on the extension used. In the latter case, suppose a hole must be drilled close to the corner of a heavy casting. The set screw which holds the drill into the extension will give trouble by striking the work. In this case *k*, *l* or *m* could be used to advantage.

To make these set screws the screw *e* is adjusted to give the required depth at *f*. Then *c* is put into *b*, the bolt *e* being put against the bottom of the chuck so it cannot unscrew if it wants to. The set screws being previously threaded they are screwed into *c*, and the heads turned up to suit. While still in *c* the screw driver slots can be cut by screwing *c* into a vise and sawing them with a hack saw, or *c* may be put into a special jig attached to the tool-post, and the slots cut with a circular saw in the lathe.

Broken pieces of steel set screws have been made into acceptable short set screws with this jig. The broken piece was screwed right into the holder *c*, and the head end *l* or *m* turned up and slotted. It was then reversed and the point turned up and cupped. Such a set screw could be easily removed from *c* by removing *e*, and then turning out the finished set screw with a screw driver. Finished screws like *j* can be cupped by removing *e* from *c* and inserting the set screw from the back, letting the head bear against bottom of hole in *b*.

Another valuable rig was made by Mr. Hamlin for sharpening the dies of a screw-cutting machine. Fig. 5 shows the dies which belong to that variety of machine which has a head something like a universal chuck, the dies being all set up by revolving a part of the chuck on head which carries a sort of scroll. A die is shown at *a*, *b* and *c*. The sharpening must be done at *d*, and the distance from *d* to the flatted place on pins *j j*, or on the clamp *k*, must be the same in the three or four cutters used in the head at the same time. Hence the face of *j* on *k* must be taken as the starting point, and the distance $j = d$ be kept the same in each set of cutters.

In grinding, the line *e* cutting the center of the screw, may be taken as a continuation of the cutting edge *e'*, the circle *h* representing the circumference of the screw to be cut. To give the necessary clearance the center of the axis of grinding may be taken in the line *f*, the small circles inclosing the centers of both diameters. In sharpening the cutters the surface *g* on *b*, and *d* on *a*, and *c*, is what must be ground off. As shown at *g* this surface *g* must be concave in one direction and straight in the other, as shown by *d* at *a*.

To grind dies for different sizes of bolts it is evident that *g* must have different degrees of concavity for larger or smaller dies. The regular emery wheel rig furnished for this purpose is cone-shaped as shown at *m*, Fig. 6. The wheel is firmly fixed to the little face plate *l*. Different diameters, and consequently different degrees of concavity, may be selected by choosing different grinding points between *t* and *u*. The gauge *p* is Mr. Hamlin's improvement, the rest *n* and cross-bearing being arranged and secured by bolt *o*. The gauge *p* is adjusted at *r* to touch the slotted pin as shown, then the gauge is fastened at *q* in the usual manner.

In grinding the bearing, *o* is adjusted to give the right angle to surface *d*, Fig. 5. In feeding the die up to the emery wheel the pin is held firmly to the gauge at *r*, by the thumb and fingers of the left hand. With the right hand the die is given a lateral motion until the space *s* disappears and the wheel stops cutting with a solid bearing of the die against *o* and *r*. The necessary clearance is given by mounting the die and holder *n* the required distance above the center of emery wheel *m*. The threading of the dies may be done upon the center *e*, Fig. 5, and only the grinding of surface *d* done upon the center *f*, this insures a bearing of the finished thread all over the surface of die *e*. In certain kinds of work it may be necessary to relieve the thread very slightly, which is done in the original cutting by deviating slightly from center *e* towards *f*.

Another handy tool-room kink from the same source is a board neatly fitted into the bottom of the lathe bed and held there by three or four buttons. The pan under the lathe can be kept clean all the week, and the board unbuttoned only on Saturday afternoons just before cleaning up time. As a good deal of hard steel is worked in the tool room lathe, a zinc or tin cover is made, which will lay on top of almost any job; being held by a slot or two through which the tool-post projects, the snapping chips are prevented from flying on the floor outside of the chip pan.

And then that little cover is so handy when the directors or stockholders are prowling around the shop looking for leaks, etc. Then, when the tool maker goes to the window to give out tools, he doesn't need to stop the lathe. He need only touch the feed button on the apron, and let the lathe run. It looks so solid to see the lathe going all the time, and the tool maker evidently doing two or three men's work all at the same time. There is where that little cover keeps the chips just where they can't get out in sight.

LETTERS FROM PRACTICAL MEN.

The Proper Method of Projection.

Editor American Machinist:

Mr. H. L. Hund's comments on Mr. Spalding's methods of projection, while right from his standpoint for some small articles, would not do at all for many drawings.

Take his own illustration of an anvil and look at it in another way, viz., a draftsman stands in front of the anvil having it at such hight that it is in his direct line of sight (which it should be if it is to be drawn correctly); then view *a* is all right; the draftsman does not move from his position, but has the anvil *turned down towards him* to get the view in plan *b;* he then has it turned up into original position and turned on its base *to the left* and sketches view *d* on his left. The anvil is then turned back to original position and turned to the right, and he sketches the view *c* on the right-hand side of the original or front view. Looking at the matter in this way makes Mr. Spalding quite right, and it is the way in which thousands of both European and American draftsmen see and draw. It is also the best and most expeditious method of drawing most machinery, as the front elevation is the view that is invariably the first to be drawn and it is much easier to project a "plan" down than it is to project it up, as the triangle covers most of the elevation when projecting *up*, while only the top of the triangle is used in projecting down, and the lines are therefore much easier to see. At least this is my opinion after 25 years' experience in such matters, and it is the way I have all drawings made for the shops, and I have always found the men to readily read them. Again, it is an easy matter to print below the various views "front," "side," "rear elevation," "plan," "section at *A B*," etc., which should always be put on details no matter which method of turning a view is used.

I suppose draftsmen will continue to differ as doctors do, and when they can get their own way they will have it in spite of anyone's method. ERNEST W. NAYLOR.

Bound Brook, N. J.

Round Test Bars Cast on End vs. Square Bars Cast Flat.

Editor American Machinist:

Before commencing to discuss the important points of Mr. Henning's criticisms of my late papers, treating the subject of testing, I wish to say regarding the report of the Western Foundrymen's Association Testing Committee, which appeared in this paper of November 28, 1894, that the appearance of the report without the discussion which took place upon it was not fair to me, as a review of the discussion would have disclosed the fact that a round test bar cast in an upright position commended itself, and was approved of by almost all the members present at that meeting, and it would also have wholly counteracted the impression that the system was a failure which the report, appearing alone, indicates. The December report of the Committee, by Mr. O. T. Stantial, is one greatly encouraging the adoption of the system, as the question of flaws is now wholly removed. In the past seven weeks' work the Committee have not found a single flaw in any of their tests, and in three or four months a final report may be expected.

Mr. Henning says my recommendations are not based on experience with making and testing round bars, and that my propositions are merely hypothetical. He has failed to show his grounds for such an assertion. Eight years' experience with round bars should entitle me to know something of their value and practicability. Professor Tetmajer, of Zurich, Switzerland, is cited as authority to prove the impracticability of casting test bars on end, and says it requires the highest skill of the molder to obtain solid bars. All I can say on this point is, that if the Professor will request it, we will take great pleasure in illustrating to him how any molder can achieve success in always attaining solid round bars cast on end.

Mr. Henning says, "The upper end of a bottom poured test bar must have a lesser specific gravity than the bottom end." I have failed to find any such results in my experience, and tests which I have lately made and could present would prove that there is practically no such a thing as a difference in the specific gravity between the upper and lower end of castings, and that if anything the top end would be the heavier.

Mr. Henning, in issue of November 22, 1894, would disprove by his figures the accepted law of there being a moment of expansion in molten metal. In discussing this question, I first wish to state that the short arm of the lever was one and one-quarter inches, and not a half inch as stated in his article. I have not taken time to check his figures, for the simple reason that the conclusions drawn from them are not verified by tests which I have made. He has figured out that the pieces of metal—blocks *B* and *H* at the ends of the test bar—were heated to at least 650° Fahr., "or a temperature that will burn wood." I can, by keeping the cope back about one inch from either outer edge of the blocks *B* or *H*, hold a finger on the middle of the top edge of either of them until after the contraction has commenced, which is about 25 seconds after the mold is poured, and after which the block commences to cool down to its normal state. The expansion commences about 15 seconds after the bars are poured, and continues to expand or move the lever for about six seconds, thus giving altogether about 21 seconds for the surface at the end of the half-inch square bar, possessing a heat of about 1,600° Fahr., to heat a cold body of iron about three-quarters inch thick, having an area of about eight inches square or 32 times larger than that from which it absorbs heat to a temperature of 650° Fahr. This, I think, is impossible. The fact of my being able to keep a finger on the hottest part of the chill until it is cold, alone proves Mr. Henning's deductions and figures to be incorrect.

If a device were arranged that could be frictionless and have no lost motion at the points of fulcrum, the long arm of the lever *E* would record a far greater expansion than it does, for I find it takes five pounds pull

opposite the touching point of the short arm of the lever to start any movement at the end of the long arm. Take into consideration this five pounds added to the weight of the block *B*, which has to be moved before expansion can move the long arm of the lever, it will be seen that this will more than counterbalance any expansion that the slightly heated block *B* and *H* may possess. Before Mr. Henning can set aside the law of expansion at the moment of solidification as being incorrect, he will have to advance other deductions.

In discussing the writer's paper on "Comparison of Strength in Specialty Mixtures of Cast-iron," read before the Western Foundrymen's Association, October 24, 1894, Mr. Henning says: "Out of all the square bars reported, 30.4 per cent. were defective against 34.3 per cent. of defective round bars. This shows the square bars are more likely to be perfect than round bars." This is new to me. I never knew before that if two different forms of patterns were kept going the rounds of several different foundries, the percentage of defective castings should always be counted on as being the same in the respective forms. But then, you know, we live to learn. Mr. Henning says there is no uniformity between the plain square bars and the turned ones, and says the latter are stronger and the former weaker than rough bars, and has given quite a long table of averages to show his comparison. He seems not to have noticed that the plain bars were of an entirely different grade of iron and cast wholly from a separate heat than that used for the rough or turned bars, and hence all his deductions on this point are worthless.

Mr. Henning now gives a table of his own deductions to try to prove that a ½-inch square bar is the best form and size to test the relative qualities of strength in cast-iron. I do not see that he proves this, and as to the "conclusive deduction to his mind," etc., I can only say that I have given his deduction careful consideration and fail to find that there should be any change made in the conclusions which I presented.

Mr. Henning desires to leave the impression that because some flaws existed in the series of tests I gave, these made the whole entirely useless for comparative purposes. I wish to say that the bars selected for a comparison were all perfectly sound with the exception of two or three bars in the weak irons, and these were more favorable in showing strength than the really perfect bars of same size in the strong irons. As an illustration of this I would call attention to the ½-inch test bar (No. 50 in the original table) standing a load of 454 pounds in light machinery iron, according to which this iron would be stronger than gun metal, chill roll, car-wheel or heavy machinery irons, as can be seen by the following table, which presents an average of tests in the respective size of bars mentioned in the grades of iron shown:

Strong or Hard Irons.	Average of ½" square bars.	Average of 1½" round bars.
	Pounds.	Pounds.
Gun metal	398	3,377
Chill roll	265	3,002
Car wheel	277	2,687
Heavy machinery	395	2,574
Weak or Soft Irons.	**Average of ½' square bars.**	**Average of 1½" round bars.**
	Pounds.	Pounds.
Light machinery	454	1,778
Stove plate	160	1,589
Sash weight	167	1,406

I think all engineers and founders will agree that the specialties as arranged in the above table are classified in the order generally accepted for degrees of strength and commercial value. No one can fail to perceive from the study of the above table that the ½-inch square bar in no wise gives us any consistent or reliable record of degrees in the true strength of cast-iron, whereas a study of the tests from the 1½-inch round bar shows us a record of a gradual increase in strength from sash weight iron up to gun metal, and I should think that the contrast between the regularity of increase in strength recorded by the 1½-inch round bar, compared with the erratic and deceiving record derived by the ½-inch square bar, would convince anyone of the impracticability of using a ½-inch square test bar to obtain any true knowledge of the natural or relative strength of cast-iron.

THOS. D. WEST.

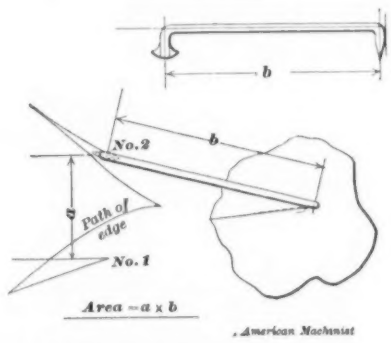
Good Shellac for Pattern Work.

Editor American Machinist:

You must have among your subscribers a good many patternmakers or manufacturing firms who have a great deal of that work to do. We have found no grade of shellac that runs uniformly good, and have had more or less trouble with it from time to time. Will you kindly invite anyone who has found a good and satisfactory article to let us know what it is, and the price?

J. E. HOYT,
Supt. Campbell Printing Press and Mfg. Co.

Brooklyn, N. Y.



A Cheap Planimeter No. 2.

Editor American Machinist:

It may not be generally known that the high-priced planimeters on the market are not the only instruments that can be used to measure irregular figures, indicator cards, etc.

A very good instrument can be made of a piece of steel wire by flattening one end into a hatchet edge and pointing the other, both ends being turned down as for a tram.

The hatchet edge must be filed to lie accurately "in line" with the point, which adjustment can be easily tested by placing the instrument ends upon a straight line, and noting whether the edge follows straight when the point is moved along the mark.

The edge must be smooth but not sharp, and there should be sufficient round up to clearly define the center of the edge when it is lightly pressed into the paper, and the distance of the mark so made from the point should be a convenient multiplier, say, 10 inches.

The instrument should be heavy enough to be unaffected by fairly careful handling, or by slight roughness, due to dust, etc., which always accumulates on paper exposed for even a few moments.

To measure the area of any plane figure locate a point in—roughly—the center of the card and draw a radial line from such point to the boundary curve.

With the hatchet edge placed in any convenient position, which is to be marked by pressing the instrument, start the tracing point of the planimeter from the center (before located) of card, follow the straight radial line to the bounding curve, which follow around to the radius again and back to the original starting point at center.

The hatchet edge will rest in a different position from that in which it was originally placed, and pressing it lightly into the paper, the distance between position s multiplied by the length from tracer to reference point of edge gives the area of the card.

The accuracy of the device can be tested at any time by running it over a square, or circle, of known area.

I have regularly used one of these instruments of my own make, and find it better for practical work than the usual complicated planimeters. The edge is easily adjusted if found out of truth at any time by simply giving the wire a twist until it follows the straight "test line."

It is hardly necessary to say that in tracing a figure the instrument is held lightly at the tracing point, so that the hatchet edge follows "free." FRANK E. WARD.

Lawrence, Kansas.

The Impact Pump—One or Two Defects in Engine Lathes.

Editor American Machinist:

It is said that an Englishman who had patiently listened to a salesman expatiate on the merits of a pump, gruffly remarked, "There is nothing in a pump but a suck and a squirt."

To whatever extent this notion prevails, or however well established may be the physical laws relating to hydraulics, the experiments of Mr. G. C. Henning as published in the AMERICAN MACHINIST of January 3d, must awaken a good deal of interest, especially among pump men.

I suppose many have observed while operating a common pitcher pump, that when actively worked, the foot valve does not drop with a thud, as when moved slowly, and indeed does not seem to drop at all. This clearly demonstrates the principle developed to so wonderful a degree by Mr. Henning's experiments.

The marvelous thing to me, in the performance of this little pump is, that the column of water being acted upon, travels so much faster than the mean velocity of the piston that actuates it, and that the momentary impact of the piston is not counteracted to a greater degree by its downward motion. For example, if the piston had moved in an upward direction only, and at its mean rate of 164.159 feet per minute, it could only discharge 66.71 gallons per minute. Whereas it appears that 75.19 gallons were discharged in addition to the air admitted with the water.

It will evidently interest all who are concerned in securing high duty in pumping engines, to know to what extent the principles employed in this little hustler can be applied to handling large quantities of water. I dare not venture an opinion on this subject.

Strangely enough, Mr. Henning's article is followed by one from Mr. F. W. Dean, which shows a saving of over 25 per cent. in fuel by utilizing pressure, and the inertia of a column of water as it approaches the pump. Perhaps if this case were followed up, it might be found that the factor of slip was not only eliminated, but became a plus, in place of a minus quantity.

Furthermore, I think these experiments throw light on the phenomenal performance of the injector, inspirator and jet pumps. That the augmented force of the steam in these instruments is the result of impact, and that the tremor felt on taking hold of an injector shows that it is numerous impulses, not unlike those effected mechanically in Mr. Henning's pump, that give the steam the mastery over counteracting pressure.

High-speed engines have had, or, I may say, are having their day. Now let us have some high-speed pumps. Of course, this does not apply to piston speed particularly, in either case.

It may seem presumptuous to criticise the construction of a machine that has become so well established in general design as has the engine lathe. But I believe there is still room for improvement on this most useful of shop tools.

The manner of giving motion to the carriage by means of a screw, or rack and pinion, situated outside the lathe shears, appears faulty to me. It is evident that the force thus exerted on the carriage tends to cause unequal wear in its bearings, especially when heavy cuts are taken and frequent reversals of the feed occur.

Tool builders have doubtless long been aware of this imperfection, and have measurably overcome it by increased length of carriage and by providing the V-shaped bearings with more wearing surface. Some builders who employ the lead screw for general turning find a remedy for the fault I have named by placing this screw between the shears and well toward the center, but this exposed position soon causes wear that unfits it for screw cutting.

There are few lathes, I think, that have been in use many years, and are geared at the side as described, but show some signs of side motion when closely observed, especially when the feed is reversed while the tool is in action.

The beginning of this defect is not easily detected; yet every machinist who runs a lathe and observes closely will be able to apply tests that will detect very slight inaccuracy in the movement of a carriage. For example, fasten a long strip of wood to the carriage in a horizontal position and parallel with the lathe shears. Any vibrations of the slide rest will thus be easily detected at the ends of this strip. The result of such a test will often prove disappointing to a person who fancies he has a very perfect lathe.

As this wabbling motion of a carriage only takes place at the time of reversing its motion, its effect is not always hurtful to the work being performed; but at times serious imperfections follow, and, indeed, I have known instances where such defects in the work done were charged to incompetency in the workman.

The rough sketch herewith shows the bad effects of a poorly fitted rest, or carriage,

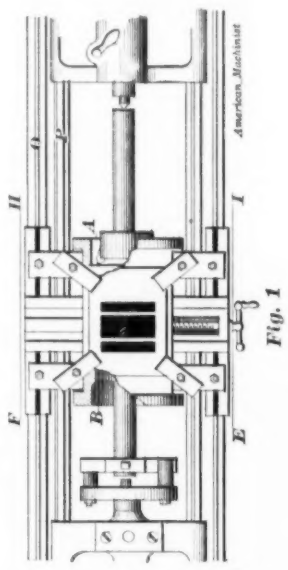


Fig. 1

ENGINE LATHE DEFECTS.

that has worn as described. If no other evil befalls the cylinder being thus bored, it is clear that the counterbore *B* will not coincide with the inner surface, as at this end the reversal of the feed will shift the cylinder, when the finishing cut through the cylinder is taken.

Furthermore, if a single boring tool is used with much cutting surface, the cylinder will be moved from side to side at every turn of the boring bar, and so produce an elliptical hole at each end, which will gradually assume a rounder form at the center, where the carriage has less vibration. The elongation of the hole in a vertical direction gives it the appearance of having been sprung in a reverse direction by clamping; but let the oversight be as it may, the fact remains that the job, in shop parlance, is badly botched.

The bearings of lathe carriages are subject to excessive wear, of course, on account of their exposure to the action of all sorts of cutting material; but if this wear was distributed alike over the whole surface of the V-shaped guides, the effect would not be so injurious.

If the defect of which I speak has not been exaggerated—and I have endeavored not to do so—it should be remedied, even though the means used involved some complications and extra cost. If the number of defective and broken racks seen on old lathes, and some that are not old, indicate weakness at this point, it might not be out of place to suggest that another rack at the back of the lathe might remedy this defect, to say nothing about giving the rest a straightforward and parallel motion.

"QUIRK."

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On the 28th of last month Mr. L. B. Moore sold his interest in the American Machinist Publishing Co., and retired from the position of treasurer and secretary—a position which he had filled since the organization of the present company in 1879. Impaired health and imperative need of opportunity for rest and recuperation caused his withdrawal, and he is now on his way to southern Italy, where he will probably remain for some time.

The purchaser of Mr. Moore's interest, and the gentleman who takes his place as secretary and treasurer of the company, is Mr. Charles W. Biglow. Mr. Biglow has had experience in technical journalism for several years, and we bespeak for him the good will and consideration of our friends.

The Manufacturers' Association.

It seems almost certain that the association of manufacturers, formed at Cincinnati during the convention held for that purpose on the 22d, 23d and 24th of last month (a report of which convention we published last week) will do a very important work in the interest of the manufacturers of the country, and not only for them, but for everybody else as well; because, of course, it is fully recognized that, while there are certain things in which manufacturers are perhaps more directly interested than any other class of citizens, yet in the end nothing is likely to benefit them as a class unless it also benefits nearly or quite everybody else in the country.

In this connection it is easy to perceive how readily such an association can be so managed as to harm its members instead of benefiting them. We have before called attention to the difference between manufacturers, pure and simple, and monopolists. The two are much too often confounded to the prejudice of the manufacturer.

A very large majority of manufacturers are not monopolists. On the contrary, they feel the full force of competition and fully earn every cent made by them above interest on investments. If the new association shall do nothing else except to make this distinction more clear than it now is, and make it better understood that the interests of manufacturers and the interests of monopolists are not identical, but rather antagonistic, it will have done a good work, and if it shall clearly recognize the distinction referred to, then such reforms or improvements in legislation or in commercial conditions as it may advocate will command the approval and support of the people generally; without which no permanent success can be attained.

In the final analysis the interests of manufacturers are also the interests of farmers, and about everybody else who is endeavoring by honest work of any kind to make a living.

We believe the management of the association's affairs is in good hands, and that it will be guided along the lines of good business principles, and with due regard to all proper and legitimate interests. It can do much to help the development of our export trade in manufactured goods, and it is clear that, according to the general sentiment of the members with regard to reciprocity treaties, subsidies to ships, increased mail facilities to foreign countries (especially the Latin-American ones) and the completion and control of the Nicaraguan Canal, they expect the association to find its greatest field of usefulness along this line of extension of foreign trade. And as foreign trade extends it is certain to benefit our American manufacturers of machinery both directly and indirectly, because not only will they find an increasing demand for their products to be shipped abroad, but they will also be called upon to build the machinery needed to manufacture the other goods shipped abroad.

Of course no association such as this can actually throw business into the laps of its members, it can only remove some of the difficulties in the way of doing foreign business, and when that is done it will still be necessary for each member to look out for his own individual interests, and in doing this he will have for his strongest competitors, perhaps, his fellow members engaged in the same line of business, and enjoying the same advantages.

There is every reason to believe that the affairs of the association will go on harmoniously, though, we think, probably more hearty co-operation of Southern manufacturers would have been secured if the protest of a Southern delegate against an executive committee so constituted as to exclude every Southern State had been heeded. Of course no one thinks for an instant that it was intended to shut them out, but it so happens that making this committee to consist, besides the general officers, of the vice-presidents from the twelve States showing by the last Federal census the largest product of manufactured goods, does exclude, and will continue to exclude, every Southern State until about the year 1901 or 1902, at least, and in the meantime, no matter how desirable it may seem in the interest of the association that one or more Southern States should be represented on the executive committee, it cannot be arranged, except by the election of such representative to the position of president, treasurer or secretary, or by changing the organic law of the association. And it would seem as though there could be no serious objection by any one to so arranging things as to allow the association to choose its own executive committee, especially when we consider that those States having the largest manufactured product, according to the last Federal census, will control the association in any event, because the clause of the constitution giving five representatives to each State, with an additional representative for each $50,000,000 value of manufactured product, will give to these States a very large preponderance of representation in the association.

It is easy to conceive of circumstances in which representatives from sections of the country not now permitted a representative on the executive committee, could do very valuable work on that committee. The proposed plan would have merely permitted such representation if in the judgment of the association it was desirable; while the plan adopted offers no opportunity for the exercise of such discretion or the extension of such courtesy.

Another Serious Blow to the Steam Engine.

A number of imaginative persons are looking eagerly forward to the near future when, it is asserted, a certain vibrating device is to thrust aside our old and reliable friend, the steam engine, as a general agent for the development of power.

The invention, which, to quote the bulletins, "consists of the core of a steam engine and the core of a dynamo," is to develop far greater power per pound of fuel than even the best of our present engines, and is to save 35 per cent. in initial mechanical friction, 15 per cent. in outside connection losses, and where electricity is to be produced, an added trifle of 10 per cent. for conversion, or a total of not less than 60 per cent. over present practice.

Last, but not least, the improved motor is to occupy but a trifling space, the machine for a fair sized ocean steamer being stowable within an ordinary silk hat of the dimensions worn by, say, one of our vindicated police justices; and such being the case, the regular greyhounds can carry power enough to make the ocean passage in a couple of days at most.

Just what connection is to be made between the vibrator and the screw, or other shafting, does not appear.

Possibly it is considered that such a trifling problem requires no particular consideration from those who soar above the clouds in scientific contemplation, and who usually leave the unpoetic practical designer to wrestle alone with the questions that arise in forcing the coarse materials of nature to conform to the requirements of geniustic theory.

It is hardly probable that the new device will very greatly interfere with the coming spring trade in the regular type of steam machinery.

Perhaps no single incident of the Manufacturers' Convention better illustrates the good common-sense principles upon which it will be run than the fact that the efforts of an individual to foist a new journalistic enterprise upon the association as its "official organ" was promptly sat down upon and squelched. Every sensible man knows that such an organ, or any organ, would be worse than useless. A paper which cannot stand upon its own feet and support itself independent of such an association, cannot possibly benefit the association nor its members. Those interested in the scheme put forth every effort, and even succeeded in having it announced in some of the Cincinnati papers that their new journalistic venture had been made the official organ of the new association, but inquiry amongst the officers of the association resulted in pointed, not to say emphatic, denials of the story.

An Explanation.

In our last issue we published a letter from Mr. A. H. Raylance, of Manchester, England, to the effect that he found it impossible to secure a proper treadle lathe for experimental work.

In so doing, we overlooked the fact that the same grievance had been given space in the columns of London *Engineering*, of January 11th, and possibly in other publications, as it has lately come to light that Mr. Raylance forwarded copies to at least one other American journal.

It is not usual for correspondents to tender matter to several periodicals at the same time.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(54) S. S. E., Lebanon, Ind., writes: Please name a set of text-books suitable for stationary engineers, and state from whom they may be obtained. *A.*—"Elementary Manual on Steam and Steam Engine," by A. Jamieson; and "Catechism of the Steam Engine," by J. Bourne, are useful books. These you can obtain from Henry Carey Baird & Co., 810 Walnut street, Philadelphia, Pa.

(55) A. E. P., Laconia, N. H., writes: Kindly inform me if there is a book published in the English language which treats exclusively of hydraulic motors, giving all the experiments in that line up to date. *A.*—"Water Wheels or Hydraulic Motors," by M. Bresse, and "Hydraulic Motors," by G. R. Bodmer, are good books, and may give you the information you seek. We are informed that a new edition of the latter work will soon appear.

(56) M. F., ——, writes: Please give rules for computing the size of the hub of a pulley. *A.*—When the pulley has to transmit as much power as the shaft to which it is keyed is capable of doing, then the length of the hub is generally made twice the diameter of the shaft plus the thickness of the arms, and the diameter of the hub is made equal to twice the diameter of the shaft. The hub and arms should be central with the face. For pulleys which do not transmit as much power as the shaft is capable of doing, the thickness of metal in the hub can be determined by the following formulæ:

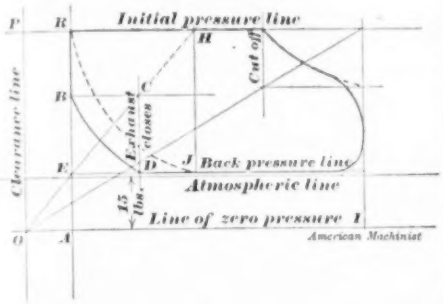
$$t = .14 \times \sqrt[3]{B \times D} + \tfrac{1}{4} \text{ inch (single belts)},$$

$$t = .18 \times \sqrt[3]{B \times D} + \tfrac{1}{4} \text{ inch (double belts)};$$

in which t = thickness of metal in the hub, B = width of rim, D = diameter of pulley, all dimensions in inches. The length of the hub in cases of this kind should be about four times the thickness of metal in the hub. For loose pulleys the length of the hub is

often made equal to the width of rim—sometimes a little longer, so as to meet the hub of the pulley keyed to the shaft; in this case the thickness of metal in the hub can be decreased a little, the decrease depending much on experience and good judgment, and sometimes on the individual preferment of the designer.

(57) L. A., Baltimore, Md., writes: Kindly inform me how to harden dies made of Jessop's steel cut from the bar, planed up and engraved on one side. They are to be used for stamping spoons, borders or medals made of sterling silver, under a drop press. *A.*—The process of hardening dies of this kind is a hazardous one and should be intrusted in the hands of experienced men only; no matter how minute the directions for hardening work of this character may be there is always a great liability of failure unless the process is conducted by a man who is thoroughly familiar with it. The lowest temperature at which the steel will harden should first be ascertained. The die may then be heated in a clean charcoal fire or in a muffle, taking care not to heat it too hot, and cool the engraved surface in water. Sometimes as a precaution against cracking, the surface is covered with prussiate of potash, or with a paste made of oil and soap, and when neither paste nor potash is used a little salt is thrown in the water in which the die is hardened. 2. Please inform me how to harden cutting dies. *A.*—These may be heated in a clean fire to a very dull red, and then rubbed with a piece of hard soap, after this the heating is continued to the required degree and then hardened in clear water, and finally drawn to the required temper.



(58) G. C. M., Athens, Ga., writes: We are troubled by the pounding and unsatisfactory working of a 9″x14″ slide valve engine, that carries 120 pounds steam and makes 150 revolutions. Can you point out the cause of the trouble? The inclosed sketch gives dimensions of valve and ports. *A.*—According to sketch, the exhaust edges are line and line, and it is more than probable that the trouble is due to want of cushion. At the given speed there should hardly be less than ¼ cushioning, that is, the point *B* in accompanying diagram should be $E\,B = \frac{1}{4}\,E\,R$. This supposes a clearance volume of about 7 per cent.—a usual value for such engines. Compute the clearance volume—from piston face to valve seat—and divide the amount in cubic inches by the cross area of cylinder; the quotient will be the relative length cylinder due to clearance volume. Draw a line *O I* (as per figure) and make *O A* equal to the above found clearance length, and take *A I* equal to the length of stroke of piston. Set up *O P* equal to initial pressure in cylinder, and take also *A E* equal to, say, 16 pounds (which allows one pound above atmosphere for increase of back pressure). From *O*—which is the "origin" or zero point of both pressure and volume—draw a diagonal, as shown, and intersect it at *C* by a horizontal from the point *B*, to which the cushion is to rise. A vertical from *C* will cut the back pressure line at the proper point *D*, at which the exhaust must close, and having this latter point the inside lap of valve can be readily found either from a drawing of the valve gear or by placing the engine piston in the proper position, and adjusting lap and eccentric to suit. The continuation of *O E* to *H* gives *J* as the point of closing exhaust to bring cushion full up to *R*, but unless there is very little clearance (say, 5 per cent.), this causes too great back pressure near ends of stroke for single cylinder engines. Your valve will *probably* require ¼″ to $\frac{5}{16}$″ inside lap, but not having drawing of valve gear this must be left for your own determination.

(59) A. E. M., Auburn, Me., writes: We are in a little mystery in regard to computing the horse-power of a compound engine of the following dimensions: High-pressure cylinder 1¾ inches diameter, low-pressure cylinder 3 inches diameter, stroke 3 inches, boiler pressure 85 pounds, vacuum 24 inches, speed 400 revolutions per minute. Please give us a rule for computing the horse-power of this engine. *A.*—The rule for computing the indicated horse-power of a compound engine has been given in answer to Question 496, in our issue of October 25, 1894. We may, however, repeat here that in computing the horse-power of a compound engine it is assumed that the work of both cylinders is done in the low-pressure cylinder. We must therefore find a mean effective pressure for the low-pressure cylinder which is equivalent to the mean effective pressures in both cylinders; the method of computing this pressure is given in answer to Question 466, in our issue of October 4, 1894. In this answer we shall simply indicate the mode of procedure in computing the horse-power of this engine. First then to find the equivalent mean effective pressure in the low-pressure cylinder, which will do the same work in this cylinder as is done when both cylinders are employed. In cases of this kind we should know the terminal pressure, which is not given, we shall therefore assume this pressure to be 10 pounds absolute. The boiler pressure is given at 85 pounds, this gives us an absolute pressure of 85 + 15 = 100 pounds. The number of expansions with these pressures will be $\frac{100}{10} = 10$, the hyperbolic logarithm of 10 is 2.303, adding 1 we have 3.303, and dividing this sum by the number of expansions we have $\frac{3.303}{10} = .33$, multiplying this quotient by the absolute initial pressure which we shall assume to be equal to the absolute boiler pressure, we have, $.33 \times 100 = 33$ pounds, this would be the equivalent mean pressure if we had not to make allowance for disturbing elements, such as clearance, radiation, friction of ports and passages, receiver "drop," initial and subsequent re-evaporation, etc., for these some allowance must be made in some way, but the calculations for their values being laborious, and involving so many assumptions as to be of doubtful accuracy when finished, it is best to allow for them at once by multiplying by a single factor, the value of which is derived from experience. For an engine of this type we may use .75 for the factor referred to above. This will give us $33 \times .75 = 24.75$ pounds for the equivalent mean pressure. Subtracting the back pressure from this, we obtain the equivalent mean effective pressure. The vacuum is given at 24 inches; this simply means that the pressure of the exhaust steam will balance 30 — 24 = 6 inches of mercury, hence the back pressure is equal to $14.7 \times \frac{6}{30} = 2.94$ pounds, and the equivalent mean effective pressure will be 24.75 — 2.94 = 21.8 pounds. We now apply the familiar rule for computing the horse-power of a simple engine,

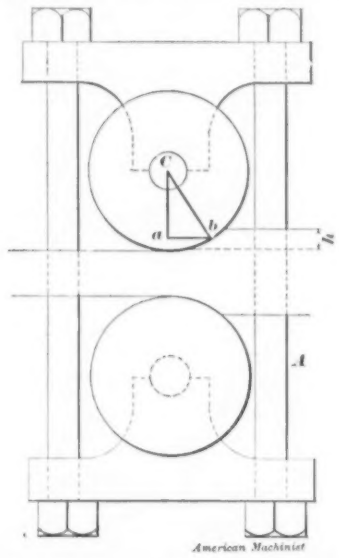
$$H = \frac{A \times P \times S}{33{,}000},$$

in which H = indicated horse-power, P = the equivalent mean effective pressure as found above, A = area of the low-pressure cylinder in square inches, and S the piston speed in feet per minute. The area of the 3-inch cylinder is 7.06 square inches, and the piston speed is $.25 \times 400 \times 2 = 200$ feet per minute. Substituting these values for the corresponding letters in the formula, we have

$$H = \frac{7.06 \times 21.8 \times 200}{33{,}000} = 0.93$$

for the indicated horse-power of the engine.

(60) M. A., ———, La., writes: The accompanying sketch shows a set of rolls driven by suitable gearing; the rolls are subjected to a pressure of 500 tons caused by the material going through; in other words, this is the pressure tending to force them apart. Please give method or the mode procedure of computing the power of an engine required to drive them. Assume your own data. *A.*—The power of the engine depends on the amount of reduction of the thickness of the metal which passes through the rolls, and the speed. Suppose that under a pressure of 500 tons the reduction *h* on one side of the sheet is ¼ inch, then the horizontal component of the force of 500 tons is found as follows: Draw a line *a b* coinciding with the center line of the amount of reduction *h*; from the center of the roll draw a line *c a* perpendicular to *a b* and terminating at *a*. Now the length of the line *a b*, that is to say, the distance from *a* to the point *b* on the circumference on the roll will represent the horizontal component of the vertical pressure or force *a c*. If the length of the line *a b* is equal to one-twentieth of the length of the line *a c*, then *a b* will represent one-twentieth of the vertical force; in short, the forces which these lines represent are directly proportional to their lengths. If then the line *a b* is equal to one-twentieth of the line *a c*, the force which *a b* represents is $\frac{500}{20} = 25$ tons, or 50,000 pounds, and if the metal passes through the rolls at the rate of 100 feet per minute, we then have $50{,}000 \times 100 = 5{,}000{,}000$ foot-pounds of work performed per minute; hence the horse-power of the engine required to do this amount of work will be $\frac{5{,}000{,}000}{33{,}000} = 151$. Here we have allowed nothing for friction, which is quite an item in this case. But, unfortunately, no rigid rule can be applied for determining the amount of friction; the friction of the gears will have to be allowed for; there is also the journal friction of the rolls, and this is affected not only by the pressure but also by temperature and the lubricant; the friction in the engine will also have to be taken into account. An addition of 30 per cent. to the horse-power as found above will probably give good results; hence, under the conditions as assumed above, we require an engine of $151 \times 1.30 = 196.3$ indicated horse-power to drive these rolls. 2. Suppose we wanted to drive this kind of rolls, leaving aside it takes 500 tons to force them apart with, say, an 100 horse-power engine, how should I go about getting out four bolts



like *A*, two on each side of the housing, to resist the full force of the engine? *A.*—You may adopt a method precisely the reverse as given above; but the size of bolts are not generally determined from such data. The maximum pressure which forces the rolls apart must be known; then divide this pressure in pounds by 10,000, the quotient will be the aggregate cross-sectional area of the bottom of the thread, and dividing this area by 4, will give the cross-sectional area of the bottom of the thread of one belt, from which the diameter is easily determined. Your other question we will answer at an early date.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 112.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, H. F. Parker, Att'y, 26 Cort'ndt St., N.Y.

Cam-Milling. Machine Tool Works, Newark, N.J.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engine Castings, 1 to 6 Horse-power Vertical. The Humphrey Foundry, Bellefontaine, Ohio.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

American packing rings are in touch with the cylinder. New circular about rings and pistons. J. H. Dunbar, Youngstown, O.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Cylinder Condensation.

By W. H. BOOTH.

I recently came across the opinion expressed in a pamphlet that the recognized action of the metal of the cylinder and piston of a steam engine upon the initial steam was doubted by the author, and as the subject has always been one that has interested me particularly, I have been induced to look up the subject to some degree to furbish up my knowledge of what different writers have had to say on the matter. Perhaps the most interesting of all I have looked up is a report by Mr. Longridge, the chief engineer of one of the boiler and engine insurance companies. He has been struck by the great difference in the performance of engines, and feels inclined when asked, Why is there so much cylinder condensation? to ask in reply, Why is there so much internal cylinder surface exposed to steam—so much needless and unnecessary surface? It is true when one comes to examine the drawings of a few steam cylinders that there are excellent grounds for the complaint. Some years ago it was always the habit to fix the piston upon the rod by means of a cotter sunk in the piston body, and held against coming out by the junk ring. The face of the piston was flush, and the cotter fitted closely sideways, and any space filled up with grease. Now, however, it is quite usual to fix pistons by means of large and deep nuts, which add a very large percentage to the area of the piston surface, and not only do they increase the piston surface, but they demand a corresponding recess in the cylinder cover, which adds a still larger percentage to the surface of the cylinder end. In my own early days cylinder covers projected only a very short distance into the cylinder, but later there came a change, and in some cylinders I helped to make and to grind the covers on, the internal projection was as great as the diameter of the cylinder in the high-pressure cylinder. The reason for this was the length of the valve chests, which, for piston valves, would have projected much beyond the ends of the cylinder if this had been fitted with an ordinary cover. This projection would either have prevented us grinding the cover faces, or would have called for greater distance between the cylinder and valve chests. Therefore the cylinders were lengthened, and the covers made to fill up the extra depth of counterbore. The covers were turned to fit the counterbores nicely, but the turning was a mere fillet only just below the flange, and the rest of the cover was left as cast, an easy fit in the counterbore, there being a space all round perhaps of a sixteenth. This annular space added perhaps very little to the volume of clearance, but it added very greatly indeed to the internal cylinder surface. Thus to secure short passages in order to minimize the clearance volumes, we were straining at a gnat and swallowing a veritable camel of initial condensation. But this does not exhaust the list of surfaces that come in for condemnation. There is the jacket formed by a liner. When thus formed the ends of the liners add largely to surface exposed. According to experiments made by Mr. Longridge, when the annular space round a cylinder cover was one-sixteenth of an inch, the extra surface, which is made up of both that of the cylinder and of the cover, acted on the steam, but when reduced to a thirty-second of an inch, it retained water, and the action ceased. It is suggested to bore the ends to a conical form, and turn the cover conical to fit very closely. The coning would prevent sticking when the cover had to be removed. Equally bad design is the admission of steam to the stuffing box right up to the metallic packing, and in Corliss valves there is the surface of the valve box and of the valve. It is often wrong to have passages for both steam and exhaust separate under the idea that we thereby prevent the initial steam coming into contact with colder exhaust passages. As a fact, is not the whole cylinder interior exposed to the tem-

perature of the exhaust, even though the exhaust port may perhaps be more exposed to the water, and robbed of more heat in evaporating this as it passes out? Still it is open to doubt whether the saving pays for the increased surface.

In Figs. 1 and 2, taken from actual practice, are to be seen samples of excessive surface, Fig. 2 showing the case also of reducing a cylinder in diameter by inserting a liner for carrying a higher pressure. The end of this liner is simply so much extra sur-

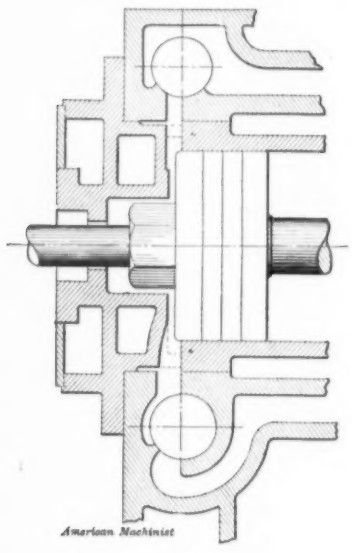


Fig. 1

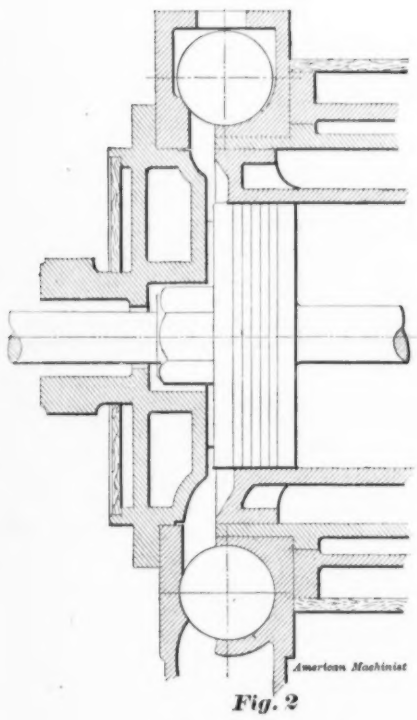


Fig. 2

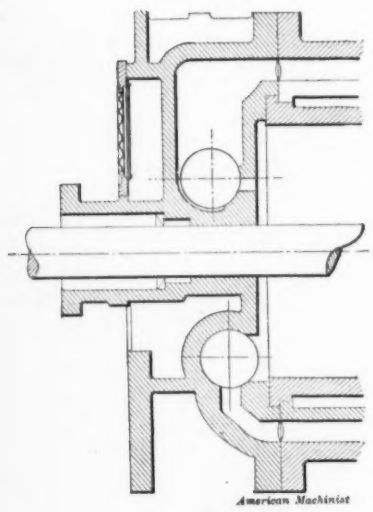


Fig. 3

CYLINDER CONDENSATION.

face. Fig. 3 is given to show how a cylinder may be designed with small surfaces as well as small clearance volumes, but it would appear more correct to aim first at keeping down to a minimum the surface of contact of the initial steam rather than at a minimum clearance, for clearance can be dealt with by early closing and compression, and only alters the apparent point of cut-off, whereas the extent of exposed surface cannot be remedied by any known practicable means. Is it not possible or even probable that the slide valve engine with slides at each end of the cylinder, and, therefore, short passages, owes its good performance to its small exposed surfaces?

Doubtless the makers of deep but loosely-fitting covers have been quite oblivious to the fact that the annular surfaces are pernicious, as if they were so much extra piston surface. There is a description in a recent issue of a certain technical paper of the engines of a United States torpedo vessel in which a habit—common to most marine engineers—is very strongly illustrated. I refer to the deep coning of the cylinder covers and pistons, concave at one side and convex at the other.

In the high-pressure cylinder, with its small diameter, this coning is very marked indeed, the hight of the cone being about as great as the cylinder diameter. In addition to the coning there is also the usual nut-fastening of the piston, and the increase of exposed surface is very great. The coning of small pistons is thus very apt to be a worse fault than the deep lid, for the latter may be made a fit, whilst nothing can undo the effect of the large surface of the cones as compared with the area of a flat piston and cover. In spite of the volumes that have been written on initial condensation, and the great efforts made by experts to remedy it, yet in the most modern triple-expansion engines we often find the little attention paid to the amount of the surfaces causing the cooling of the steam. Surfaces needlessly large, rough just as cast, are left to work their will instead of being all polished (if not nickel plated) and reduced to the least possible area.

London, Eng.

Machine Shop Milling Practice—XVIII.

BY HORACE L. ARNOLD.

The usefulness of a large end mill which can be worked in both horizontal and vertical planes is well exhibited in the four following figures, which show how long side frames are milled in pairs, first on one edge, and afterwards spotted on this first edge cut, and then milled on the other edge and both ends without resetting, thus insuring the truth of the job with itself. Fig. 96 is a side and plan of the frames with the long cut in process, with the 15½-inch face mill on the vertical spindle. Fig. 97 shows the long end cut with the facing mill on the horizontal spindle. Fig. 98 is from a photograph of the machine making the short end cut with the mill still on the horizontal spindle, and Fig. 99 is also from a photograph, and shows the long cut made with the mill on the vertical spindle. As will be seen, with nothing more cumbersome or awkward than the two tool saddles commonly placed on a planer rail, the Ingersoll machine is capable of making cuts on the top and both sides of a piece by the use of a turn-about fixture for holding the work, and this fixture is of the very simplest description; merely a flat fixture such as would be used on a planer, if many pieces of one pattern similar to that of the frame shown were to be finished. This feature of the employment of a vertical spindle attachment is not new, but the size, efficiency and convenience of the form adopted in the "Ingersoll" gives the idea an entirely new significance. Instead of a mere attachment it becomes a harmonious element of the original design, and gives, practically, a new function to the horizontal spindle milling machine which is of the greatest working value. The single example given in Figs. 96, 97, 98 and 99, shows how this vertical spindle gives the "Ingersoll" the ability to finish pieces which would be entirely beyond the powers of slabbing machines in our usual American forms. The face mills used for this frame job were 15½ inches diameter, with 37 teeth, 14 revolutions, and 2½ inches feed per minute.

Great pains have been taken with the "Ingersoll" spindle support in the 36-inch size. As will be seen from Fig. 100, detail, the double cone is used at the nose, in the saddle which slides along the cross rail, so as to obtain the perfectly adjustable journal support needed to carry a large over-hung face mill, as well as to sustain the very heavy work due to the use of a slabbing mill 36 inches long. The spindle is 7¼ inches diameter, outside the nose, and the taper socket

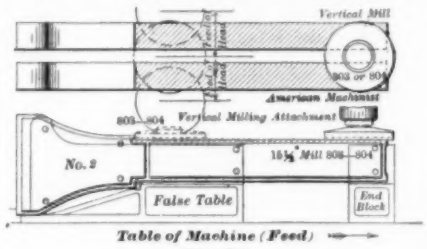


Fig. 96

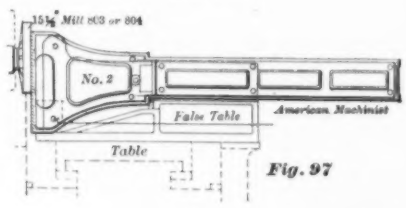


Fig. 97

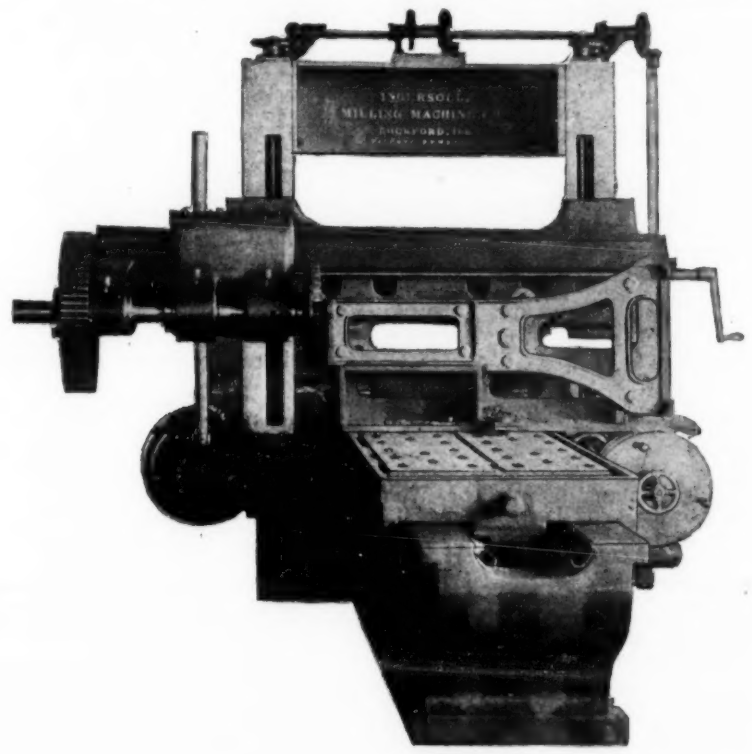


Fig. 98

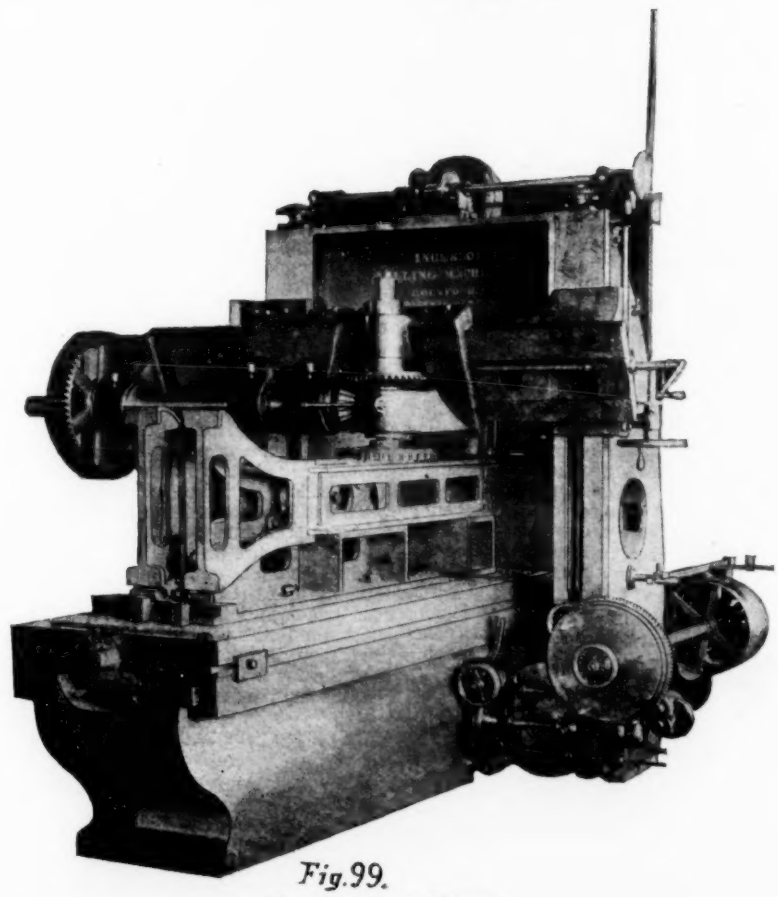


Fig. 99.

MACHINE SHOP MILLING.

for the mill arbors is 3¼ inches diameter outside. The out-board bearing is straight, but is provided with a taper sleeve and bush, so that it can be taken up to an exact running fit. The vertical spindle is presumably a duplication of the main spindle end, with the same double cone bearing and taper socket, as no separate drawings for the vertical spindle have reached me. These spindle diameters and bearings are in excess of previous American practice, and are perhaps not so very much below what the settled practice of the future will be; they are surely not larger than is needed.

The general arrangement of the table drive and the feed details are substantially the same in Ingersoll's 24-inch and 36-inch machines, and the construction sheet, Fig. 101, of the 24-inch machine, which is here given, shows essentially the general arrangement of both. The only marked difference is in the feed transmission from the spindle drive on the back of the machine to the table feed work on the front of the machine. In the 24-inch, this transmission is through a worm shaft led directly from the feed disk on the front end of the spindle drive cone shaft across the frame underneath the table to the under side of the large feed shaft worm gear. In the 36-inch machine this transmission is effected by a rope, passing partly through and partly under the frame, from a shive on the main cone shaft to a shive on the feed disk shaft; this is not

nearly so direct as the 24-inch feed drive, nor is it nearly so certain in its operation. The general scheme of the feed, including the quick handling table action is ideal; nothing better could be desired, and the workmanship of the machines is very good indeed. The rack-driving worm has a ball-bearing thrust collar, the details of which are not in my possession, but, judging from the examples of wide cuts I saw at the Watts-Campbell shops, the thrust is very thoroughly taken care of, indeed, as a cut 27 inches wide and $\frac{3}{16}$ inch deep was handled at $2\frac{3}{8}$ inches per minute with a very weak drive of the friction disk, as detailed in a previous paper.

Fig. 102 gives the countershafts of the 36-inch, and general driving arrangement. Designers interested in milling machines will recognize the value of the blue print reproductions given herewith.

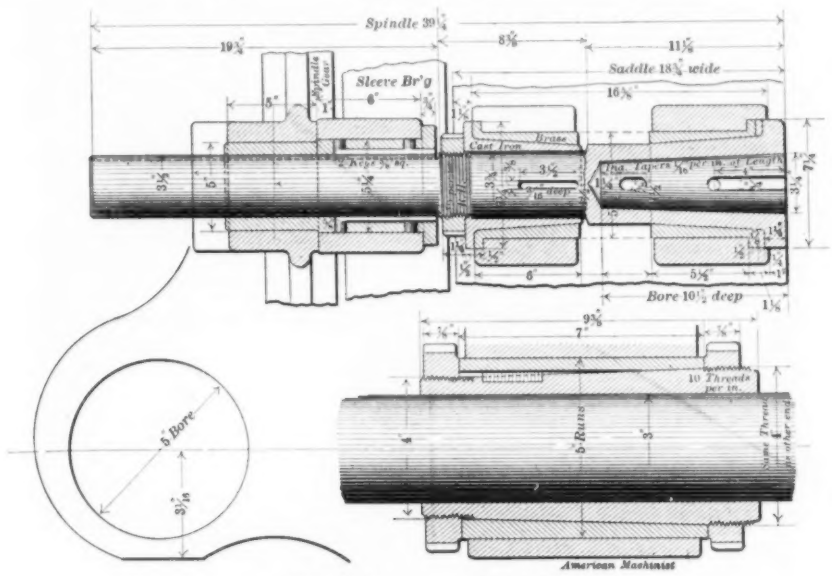


Fig. 100 *Mandrel Bearing,*

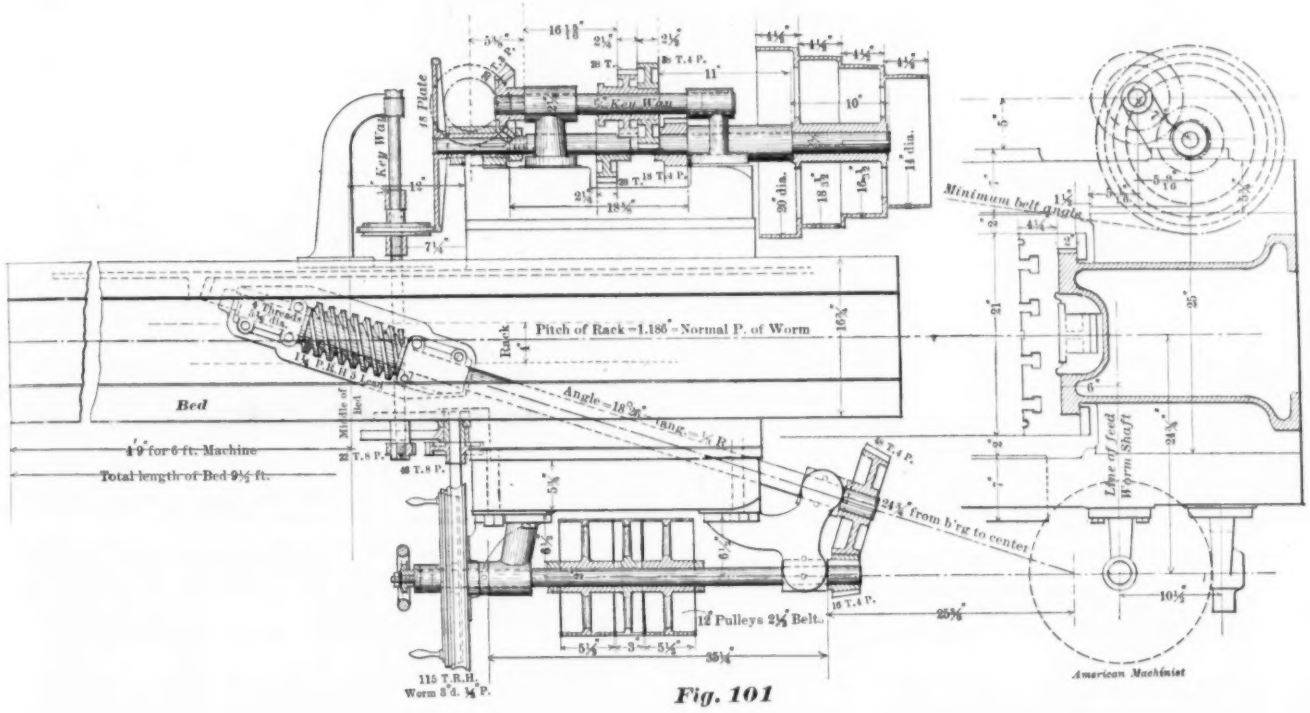


Fig. 101

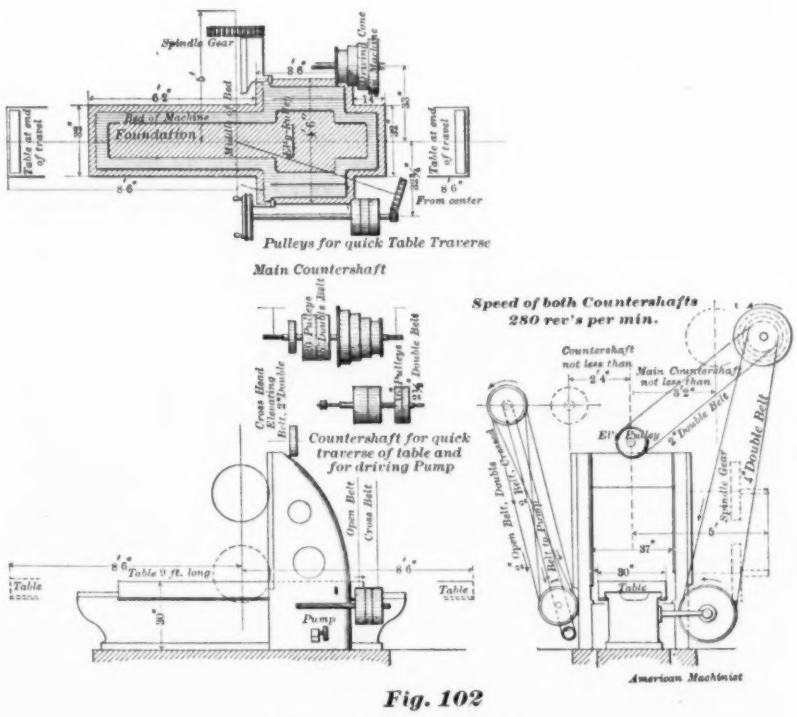


Fig. 102

MACHINE SHOP MILLING.

Rating of Feed-Water Heaters.

We have received a circular from the Taunton (Mass.) Locomotive Mfg. Co., in which they state that on Saturday, January 26th, makers of closed feed-water heaters held a meeting at the Astor House, New York, and an organization was effected and resolutions adopted binding the subscribers after March 1, 1895, to offer such heaters for sale only on the basis of the number of square feet of surface contained in the heater, and, further, to show how this surface is calculated, by giving the diameter of the tubing, and the lineal feet thereof, as well as the total number of square feet contained in the heater.

We understand that this action was taken in order to remedy the abuses which had arisen from the present practice of rating such heaters by horse-power, which, of course, allowed each builder to rate his heater in accordance with his own individual conception of its capacity; the result being such an anomalous condition as was referred to in some of the discussions at the December meeting of the American Society of Mechanical Engineers. The company referred to state that this action of the association is in accordance with their practice in regard to the Wainwright corrugated copper tube feed-water heater.

In some recent experiments with smoke prevention in Glasgow as reported, the coal used showed 31.40 per cent. gas, tar, etc.; 48.70 per cent. of fixed carbon, 0.84 per cent. sulphur, 6.56 per cent. ash, and 12.50 per cent. water. Before treatment analysis showed that the products of combustion contained 5.8 grains of sulphuric acid per 100 feet cubic, and after treatment 2.8, while in another case the reduction was from 9.5 to 4.2. As to soot, the first test showed a decrease from 78.5 grains to 2, and the other test from 23.3 to 1.5 grains. In other words, from 94 to 97 per cent. of the soot was removed, and fully a half of the sulphuric acid, and tests showed that the draft was not affected, being five inches in the flue and four inches in the chimney. The boiler used drove a 220 horse-power engine, consuming three tons of coal and one-half ton of scraps and chips. Before entering the usual chimney the gases ascend a short brick flue and then descend a flue of steel plates dipped at a high temperature in a tar composition, entering the ordinary stack at the bottom. A jet of steam at boiler temperature is at the bottom of the ascending flue, while at the top of the descending flue is a fine spray of water. The carbon is thus separated, and, with the water, drops into a sump at the foot of the descending flue, being carried off in pipes.

In our description of the Lodge & Davis shaper, issue of January 24th, we inadvertently omitted to notice an improvement designed especially to admit of passing work through the column under the ram. To effect this the usual slotted arm is fork-shaped, and attached to the nut by a double link.

The College Engineer.

Much has been said and written concerning the capabilities of a technically educated man for practical work, but the subject was never before brought so forcibly to my mind as it was a short time since while in conversation with the superintendent of a large company engaged in the building of steam engines and boilers.

This superintendent wished to engage a man to inspect and test the engines before they left the shop, to see that all was right, *i. e.*, he was to look the engine over to see, as far as observation could detect, that there were no faults, such as leaky cylinders, loose rings, etc., and, he was to run, or superintend the running, to see that the speed held up at different loads; adjust the governor, etc., or, in full, to make sure that all was right before the engine was allowed to leave the shop.

A young man of about twenty-six or so, presented himself for the position and in giving his experience, mentioned that he was a graduate in mechanical engineering from a technical school, and was surprised—aye, stunned, to receive the abrupt reply, that his education would be a damage to him, that said superintendent "had previously had experience with two or three of his class, and had found them sorely wanting." This superintendent told me that the "technical men" he had employed to work for him were always going to revolutionize things by doing such "big things," as he termed it, and that they were always taking steps which they assumed (but never quite knew for sure) were right, and would continually bring out their "theory" in defense of the steps taken, and continuing in this strain, he said "that he did not think that the college *professors* knew it all either."

I could not but feel that my informant had been unfortunate in having to deal with some very poor samples of technically educated men, and in suggesting this to him, was told that there were *probably* some technical men who were all right practically but that in his experience he had failed to find them.

I asked the names of some of the graduates rated as failures, and among others he chanced to name a young man with whom I was at one time quite well acquainted. He said that this young man had worked for him before going to college and that when he returned, he did not know, or handle anything quite as well as he had before entering school. I do not know how good a workman this man was, or what position he filled before going to college, but it has always been my opinion that such men, one of whom I knew him to be, were a damage to the engineering profession, and that they were responsible in a great degree for the slurs cast upon the "college engineer" by non-educated practical men.

Having had frequent opportunities to observe this young man's work in college I noted that he seldom did any original work, always trying to imitate the methods found in books, or the work of his classmates, without having any clear idea as to just why he took a particular step in the solution of a problem, or the demonstration of a mathematical formula. In his laboratory and testing work he usually followed closely the rules set down by his instructors; filling out reports according to precept, and his whole aim appeared to be to get a good percentage mark on his term record, without appearing to care whether or not he knew anything about what he had been doing.

This class of students usually succeed "by hook or by crook" in securing good class records and at the completion of their college course are "turned loose" on the world as "engineers of good standing," and are falsely rated on a par with the—I am happy to say—larger percentage of graduates, who *do* know something about their profession.

I am loath to say that the systems in vogue for the gradation of engineering students are sorely lacking in their ability to detect these students who have a lack of practical originality, and of debarring them from entering a profession for which they

are so little fitted. We find in all professions some men more capable than others, due either to the capacity or energy of the man, usually more particularly due to the former which is in a degree an outcome of the latter quality, and the man who has uncomplimentary remarks to make of any class or profession, will do well to first consider whether or not his decisions have been influenced by contact with those of a low grade in their calling; especially will this apply to the mechanical world.

I think I will be upheld by all fair-minded men, in the statement that any person in doing a piece of work, other than mere drudgery, can do it better if he is a trained man than he could if he were lacking in technical knowledge.

I have frequently come in contact with mechanics who were puzzling over some piece of work when some slight explanation in geometry or trigonometry has caused them to remark that if they had just known that before it would have saved much trying and fitting, and often have I had machinists or ironworkers tell me that "they wished they did know something of the theory of the thing."

Of course the college man has his positions which he is especially fitted to fill, and while he cannot do quite as fine a piece of work on the bench as a machinist is expected to turn out, yet I would ask, where is the superintendent or foreman who can do as slick a job as the workmen under him? The function of the technically educated man is to design and superintend the work done by the mechanic, and by virtue of his advanced education if he be of the right type, he is far superior to the man who knows only the way and not the why.

In conclusion, let me repeat that before anyone assumes to denounce the "college engineer" he should first look to see if his conclusions have not been drawn from men of small capacity, and let him compare the technical graduate with the man of *similar capacity* who is without a college training.

F. P.

NEW CATALOGS.

We have received from Wells Bros & Co., Greenfield, Mass., a small catalog illustrating and describing their specialties in taps, dies and machinery for the use of same. It also includes illustrations of hand lathes, slide rests, cutter grinders and twist drills.

Mr. John Acton, 79 Washington street, Brooklyn, N. Y., has issued a small catalog of steam and water specialties which include pump governors, regulating and reducing valves, waterworks reducing valves, pressure regulating valves, and other steam and waterworks devices.

We have received from the Bigelow Co., New Haven, Conn., a finely illustrated and printed catalog descriptive of the Manning vertical boiler. It gives considerable information regarding this boiler, including tests of it, and will be found of interest. This catalog comes pretty near being standard size, yet is not, being 5¾"x9".

We have received from the Howe Pump and Engine Co., Indianapolis, Ind., a small catalog illustrating their combined chemical and water fire engines and fire apparatus generally, intended especially for localities where the more expensive apparatus cannot be purchased or maintained, but where nevertheless some fire protection is important.

We have received from the Penberthy Injector Co., Detroit, Mich., a catalog illustrating and describing their specialties, which include the well-known Penberthy injector and special connections to the same, and also water gauges, lubricators of various forms, etc. If three-eighths of an inch were trimmed off from the length of this catalog, it would be standard size (6"x 9").

MANUFACTURING

At the Davis & Furber Machine Co.'s plant, North Andover, Mass., work was resumed on full time January 7th. The shops had been running only eight hours per day.

Henry F. Parker, solicitor of patents, at 26 Cortlandt street, New York, is sending out a desk calendar of novel construction, arranged for conveniently making and preserving memoranda.

The Lunkenheimer Co., of Cincinnati, Ohio, evidently wishing to send their large catalog to those who want it, and yet avoid sending it to those who do not want it, send first smaller and less expensive printed matter with a blank addressed postal card to be filled out with the address of those who thereby signify that they would like a copy of the larger publication.

Architects are making plans for the new plant of the Albro Clem Elevator Co., to be located and erected at once at Seventh street and Glenwood avenue, Philadelphia, Pa., on a large tract of ground recently purchased by the company. The Pennsylvania Railroad and the Philadelphia & Reading Railroad will have sidings into the works. This plant when completed will be one of the largest and best equipped in the country for the manufacture of passenger and freight elevators and elevator appliances of every description.

The new power station for the United Electric Light and Power Co., of New York, N. Y., is now being put in place by the Berlin Iron Bridge Co., of East Berlin, Conn. This will be one of the largest and most complete plants in the United States. The engine and dynamo room is 100 feet square, and the boiler room is 60 feet by 100 feet. The engine and dynamo room is to be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. The coal pockets over the boiler room will have a capacity of 3,000 tons of coal.

Machinists' Supplies and Iron.

New York, February 2, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10 25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10.75 for No. 1 soft; $10.25 to $10.75 for No. 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—There is no change in the market. We quote L. X., 8¼c. to 8¾c.; Cookson's, 8½c. to 8¾c.; Hallett's, 7.30c. to 7.35c.; and U. S. French Star, 8c.

Lard Oil—Prime City we quote at 53c. to 54c.

Copper—The market remains quiet but firm. Lake Copper is quoted at 10c., at which some routine business has been done. Casting Copper is dull but steady at 9⅝c. to 9¼c.

Lead—The market is quiet and steady. Holders demand 3½c., New York delivery, and are not very free in their offerings.

Spelter—The market remains flat. The production is greater than the demand, which is likely to prevent higher prices in the near future.

Tin—Towards the end of the week the market was rather unsettled and dull, and business is conducted with caution. Spot is quoted at 13.75c., and 13.20c. to 13.25c. for February delivery.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Draftsman, six years' experience, college graduate, wants position. Address J. J. L., Am. Mach.

Wanted—Situation by A1 machinist as foreman of job or small mfg. shop. Box 108, Am. Mach.

Wanted—Pos. by skilled engineer and machinist. Address 575 Grand street, Jersey City, N. J.

Wanted—Position by skilled mechanical draftsman, A1 references. Box 111, American Machinist.

Practical and experienced draftsman wants position. Address K., American Machinist.

Situation as foreman of foundry; experienced in all kinds of machinery castings. Address P. O. Box 1006, Providence, R. I.

Draftsman, 15 years' exp. as designer of steam engines, electric and gen. mach'y, seeks pos. as chief draftsman. Chief Draftsman, Am. Machinist.

Wanted position as foreman—Patternmaker, ten years' exp. with large heavy work, foreman at pres. with large firm, wishes to change. Box 95, Am. Mach.

Engineer (mem. A. S. M. E.) at present superintendent of manufacturing concern desires changing location to New England; will consider salary or purchase of interest. Box 100, care Am. Machinist.

Foundry foreman wants to make a change, with 10 years' experience as foreman of all classes of work, can furnish reference, age 35 years. Address Box 109, American Machinist.

Competent machinist with 15 years exp., good habits, best of refs., wants permanent position, would not object to small town; jobbing shop preferred. Address W. D., American Machinist.

Foreman of large machine shop desires to go South, well posted in gen. machine shop work also millwrighting; best of refs.; 9 years foreman; a hustler; 31 years old. H. B. J., Am. Machinist.

Wanted—A manager for a steam forge, comprising smith shop and fully equipped machine shop. Applicants please apply by letter, with full particulars and references. Address Room 75, 54 William street, New York City.

Wanted at Cleveland, Ohio—Foreman for small machine shop working on repair work; applicant must have prac. experience with fair education. Address in his own hand writing, stating age, exp., education & wages expected, Box 92, Amer. Mach.

Wanted—A position as supt. or foreman; 28 years exp.; watch tools & automatic mach'y, sewing machines and tools, jigs, dies, etc; have had charge conversant with mod. methods; familiar with shop accounts. 1st-class ref. Box 102, Am. Machinist.

(*Continued on Page* 113.)

REDUCING VALVES

For reducing and maintaining an even steam, air or water pressure. These valves have been on the market for years, and are used by all the best and largest steam plants of the world.

MASON REGULATOR CO., Boston, Mass.

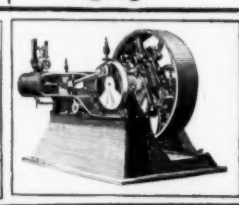
Buffalo Fan System of Heating & Ventilating All Large Buildings. By a forced circulation of warm air. Buffalo Forge Co. Buffalo, N. Y. Chicago Office, 22 W. Randolph St.

Steam Engine Catechism, by Robert Grimshaw, M. E. 18mo, Cloth, - - $2.00. John Wiley & Sons, New York.

Grant Gears

Ready Made Iron Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
1895 Gear Book, Free.
Treatise on Gears, $1.00.
George B. Grant, Lexington, Mass., and 125 South 11th St., Philadelphia, Pa., and 86 Seneca St., Cleveland, Ohio.

The Sturtevant Patent Hot Blast Steam Heating Apparatus. Combined Steam Fan & Heater for Ventilating and Drying. Send for catalogues. B. F. Sturtevant Co. Boston, Mass.



The Sturtevant Automatic Steam Engines. Horizontal & Upright. Send for catalogues to B. F. Sturtevant Co. Boston, Mass. New York, Phila., Chicago, London.

BORING AND TURNING MILLS

ARE SUPERIOR TO LATHES FOR FACE PLATE WORK.

We have a variety of sizes and a large stock for immediate shipment.

THE BULLARD MACHINE TOOL CO.,

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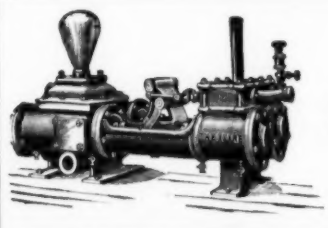
New York Office, 86 LIBERTY STREET.



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ARE THE FINEST STOCK KNOWN FOR SMALL TOOLS.

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HIGHEST QUALITY.—TAPS, DIES, REAMERS,

Screw Plates, Tap Wrenches, Bolt Cutters, Drilling Macnines, Punching Presses, etc.

Send for catalogue.

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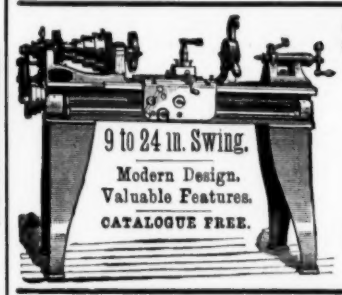
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.

Sole Representatives in the United States.

B. M. JONES & CO.,

Boston: 11 & 13 Oliver St., New York: 143 Liberty St.



Speaking of LATHES!

We are building them in various sizes from 10 inch to 24 inch swing, in various lengths, both engine and speed lathes. Our designs are the latest and most approved, while the workmanship, material and finish are of the highest order. Our catalogue will tell you all about them, as well as of our planers, shapers, drills and other tools and supplies. A postal will bring it. Write us for prices.

SEBASTIAN LATHE CO.,

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H. W. JOHNS'

ASBESTOS SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, Etc.
Asbestos Boiler Coverings.

H. W. JOHNS MANUFACTURING COMPANY,

H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.

87 Maiden Lane, N. Y. Jersey City, Chicago, Philadelphia, Boston, London

Wanted—Superintendent, middle-aged, active, progressive and intelligent, to take charge of shop (in wood and iron line) employing about 175 men, and business increasing. Reply should be comprehensive as to past exp., with whom, nativity, age, and salary expected. F. C. Austin Mfg. Co., Carpenter street and Carroll avenue, Chicago, Ill.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd,O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses,engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E O Chase, Newark, N. J.

Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

"Draftsmen's combination triangles clean, transparent, tough." D. J. Kelsey, New Haven, Conn.

Model Locomotive Castings. Latest design. G. H. Olney, 163 Herkimer street, Brooklyn, N. Y.

Bargains in tools and machinery. Send 6 cents for ill'd catalog. Frasse Co., 17 Warren St., N. Y.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Cheap 2d-hand 16 in. eng. lathes, and a 200 to 400-pound steam hammer. W. C. Norris, Tiona, Pa.

Wanted—Special machinery patterns, tools, dies, articles of hardware to build. Address Passaic Falls Machine Co., 34 Sheridan Ave., Paterson, N. J.

Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

Wanted—Aluminum and brass castings to make, lowest prices for satisfactory work; prompt delivery; correspondence solicited. Tinning Campbell, brass founder, 153 Liberty St., Paterson, N. J.

Additional Capital Wanted—Two mechanical engineers, who have secured patents both here and in Great Britain for two water tube boilers, suitable for marine purposes, torpedo boats and steam yachts, desire to interest one or two gentlemen of means to furnish additional capital for manufacturing purposes. The advertisers are holding responsible positions in first-class shipbuilding firms, and are men of great experience as designers and engineers; references given and required. Address BOX 110, AMERICAN MACHINIST.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.

Machinist's Size.

No.	Range	Price
1	⅛ to 1 in.	$10
2	1 " 1½ "	14
3	1½ " 2 "	18
4 (with screws)	2 " 3 "	32
5 " "	3 " 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
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SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.

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FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
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WM. JESSOP & SONS, LTD.
Established a century ago.
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TIME SAVED IS MONEY SAVED.
STYRIAN TOOL STEELS
will save you time in labor by wearing longer without resharpening.
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SOLE AMERICAN AGENTS,
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DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING NICHOLSON.
NICHOLSON FILE CO.
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3000
VARIETIES FILES
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DROP PRESSES·DROP HAMMERS·STAMPS
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LARGEST LINE IN MARKET.

MARK YOUR TOOLS WITH A STEEL STAMP.
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CLEVELAND, OHIO.
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PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
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WORCESTER, MASS.
Manufacturers of Set, Cap & Machine Screws, Studs, etc.

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EXPERIENCED IN DESIGNING HEAVY MACHINERY, POWER PLANTS AND MACHINE SHOPS.
PLANS, SPECIFICATIONS, SUPERINTENDENCE AND THEORETICAL TESTS.
REFERENCES BY PERMISSION.

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An Indispensable Tool for all Bench Woodworkers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.
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THE TAYLOR-RICE ENGINEERING CO.,
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ADJUSTABLE BLADE REAMERS
½ in. to 2½ in.
Send for New Pamphlet.

ABSOLUTELY K & M FIRE-PROOF.

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New York, Robert A. Keasbey, 54 Warren Street.
Philadelphia, Macan & Co., 1420 Callowhill Street.
Baltimore, Wallace & Bro., 432 East Pratt Street.
Washington, Wm. B. Morgan, Room 19, Builders' Exchange.
Chicago, Walch & Wyeth, 208 Lake Street.
New Orleans, Delbert Engineering Co., 23 Union Street.
Memphis, Symmes & Co., 162 Front Street.
Milwaukee, Wis., F. Sprinkman, 133 Sycamore Street.
St. Louis, F. Bocler, 108 Walnut Street.

THE GREAT COAL SAVER.
Manufactured by THE KEASBEY & MATTISON CO.
CINCINNATI: 114 W. Second Street.
AMBLER, Pennsylvania.
CLEVELAND: 117 Water Street.

SELLING AGENTS.
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Minneapolis, Arthur L. Otto, 429 Boston Block.
Des Moines, J. C. & R. B. Carter.
Omaha, Spencer Otis, 310 S. Sixteenth Street.
Kansas City, J. H. Storer & Co.
Denver, C. W. Badgley & Co., 18th and Market Streets.
Salt Lake City, Utah and Montana Machinery Co.
Butte City, Montana, R. W. James.
Montreal, Sclater Asbestos Mfg. Co.
San Francisco, De Solla & Deussing, 2 California Street

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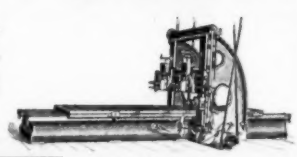
YOU WILL FIND THEM AT
FITCHBURG Machine Works, Fitchburg, Mass.
First Class Metal Tools
SEND FOR CATALOGUE E. AND LIST OF GOOD 2d HAND TOOLS.
INSPECT OUR
PRACTICAL POWERFUL PLANERS AND OTHER METAL WORKING MACHINERY.



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YOU will JUDGE them EXCELLENT.

BUILDERS IRON FOUNDRY,
FOUNDERS AND MACHINISTS,
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HEAVY ACCURATE MACHINE WORK.
Our skill as machinists and the character of our machine shop facilities for heavy work are indicated by the 12-inch Breech Loading Rifled Mortars and Spring Return Mortar Mountings made for the United States Government. Pamphlet reprinting the official reports which describe these guns mailed upon application.

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Lot of 6½ in. and 7½ in. Hammered Steel Shafting, Couplings and Chain-feed, Self-oiling Pillow Blocks. 60 x 14 Friction Clutch Pulleys. 46 x 38 and 40 x 27 Clutch Pulleys. 80 x 20 Pulley. 72 x 20 Split Pulley. 60 x 12 Pulley. Also other sizes, good as new, at less than half value.
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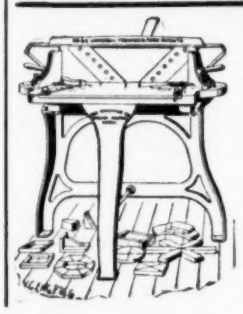

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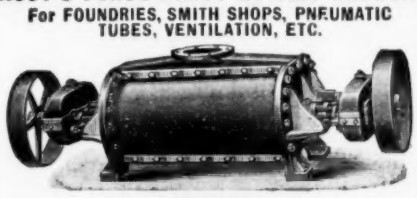

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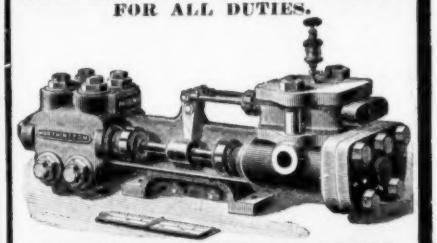

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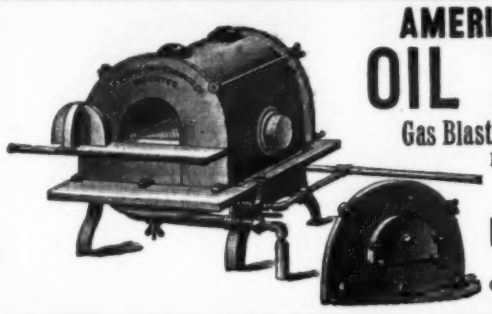

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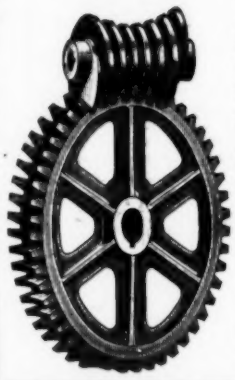

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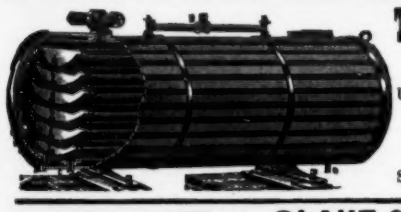

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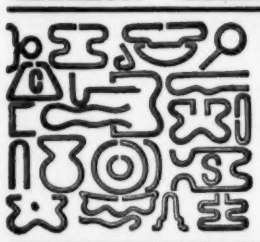

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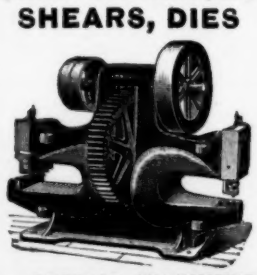

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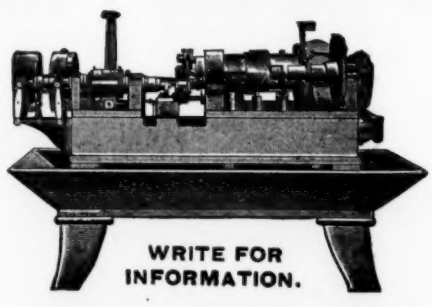

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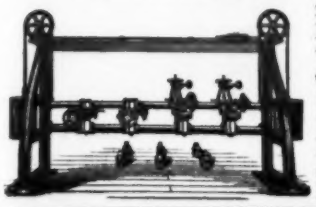

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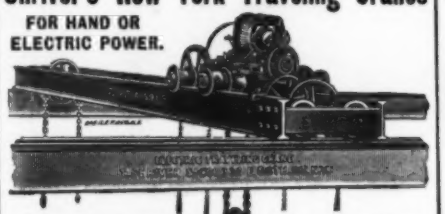

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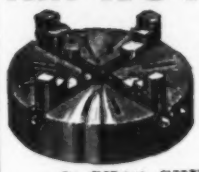

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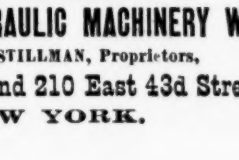

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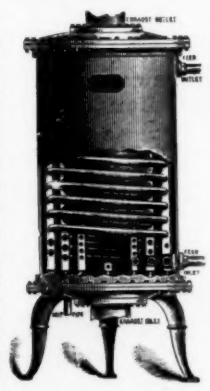

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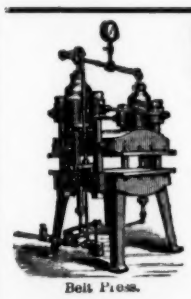
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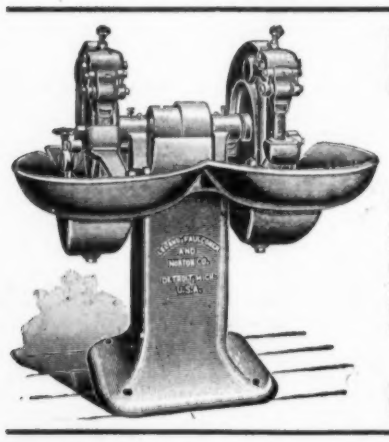

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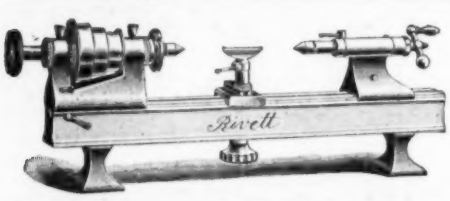

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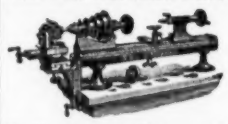

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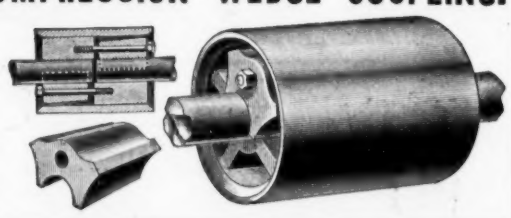

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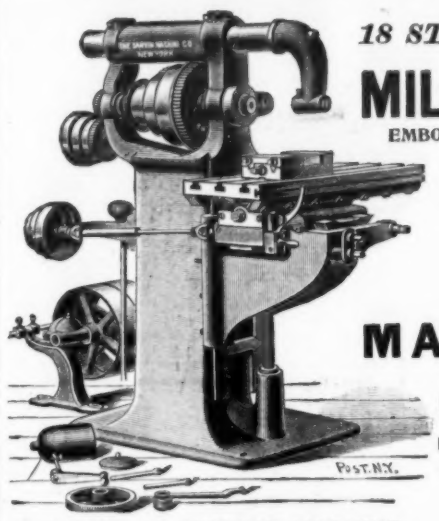

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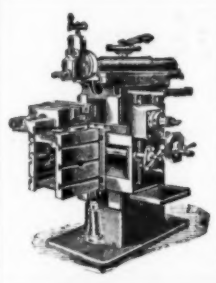

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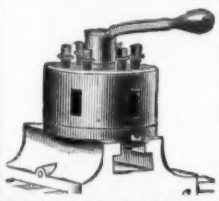

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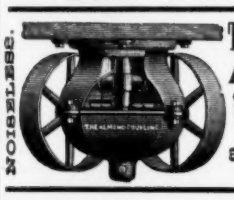

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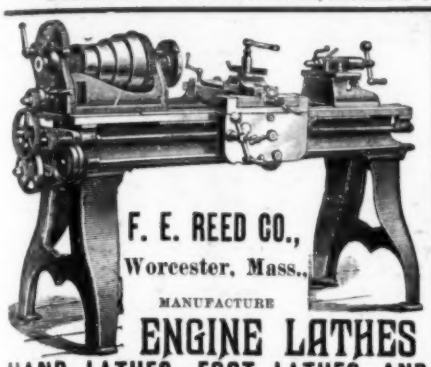

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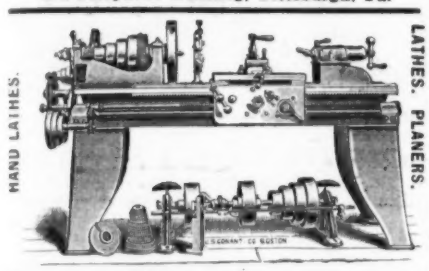

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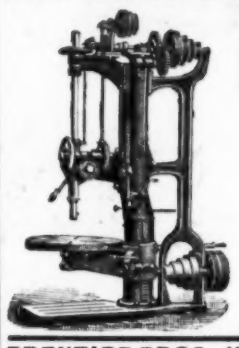

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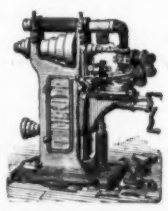

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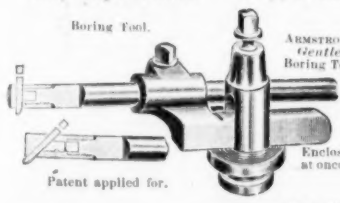

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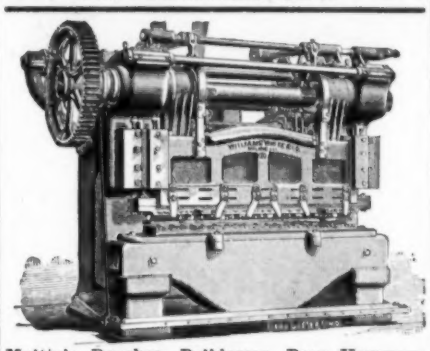

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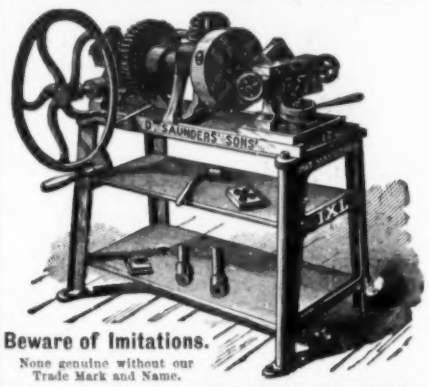

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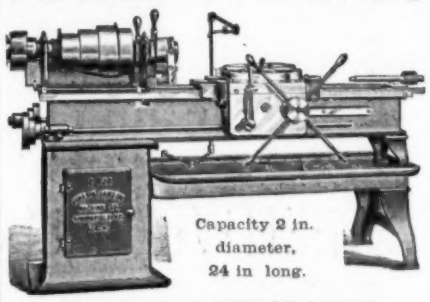

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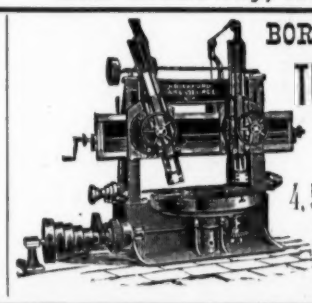

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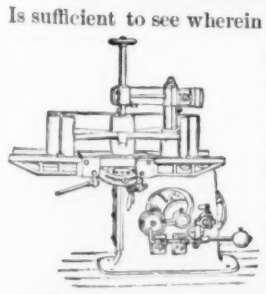

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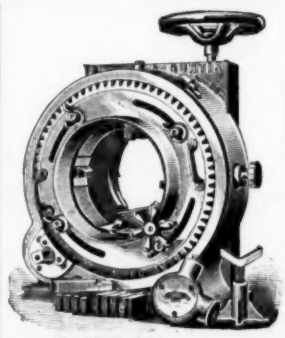

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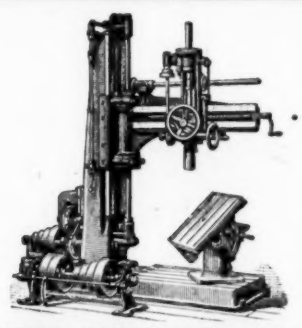

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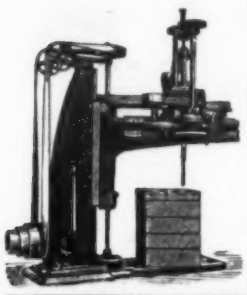

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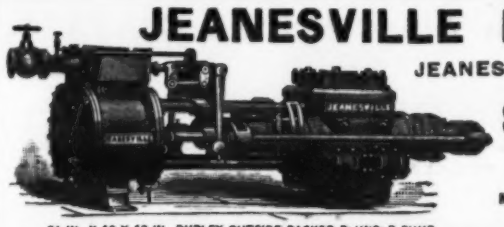

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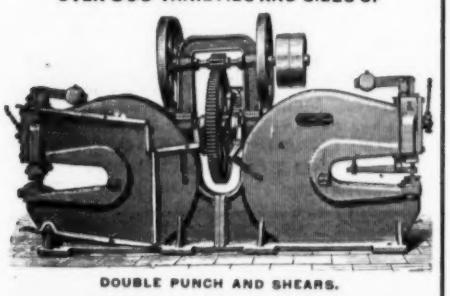

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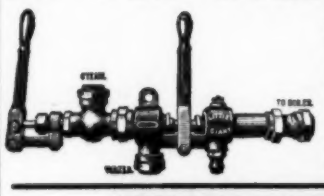

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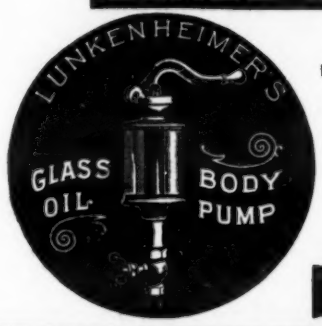

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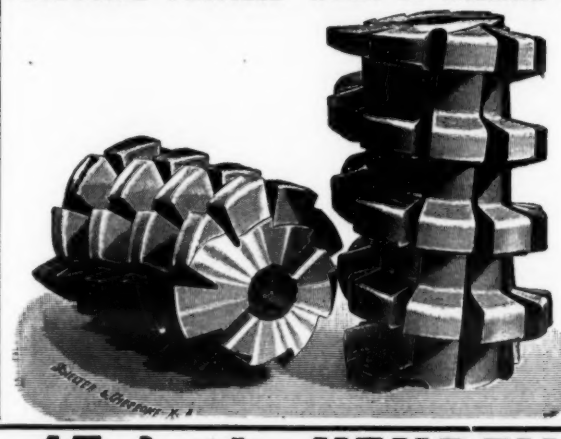

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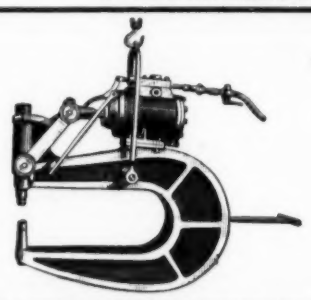

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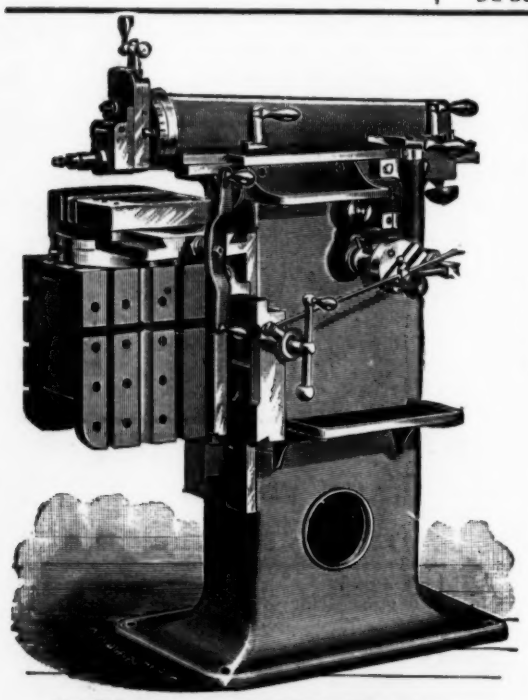

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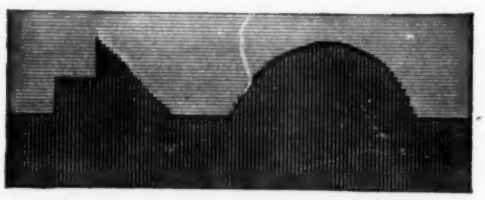

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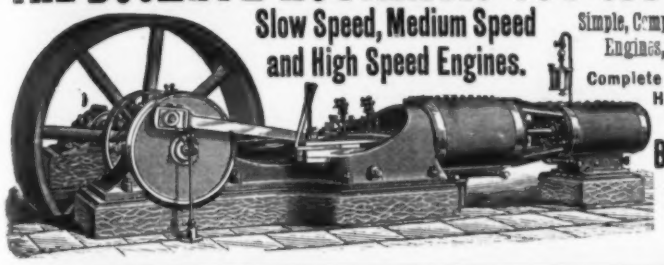

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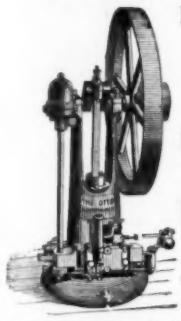

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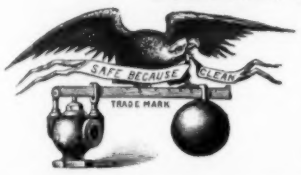

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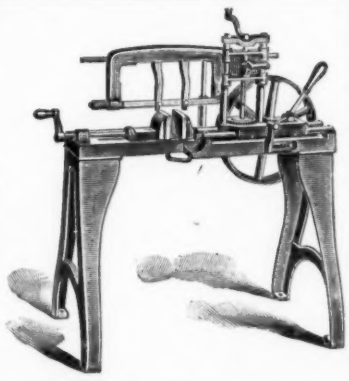

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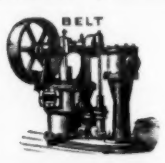

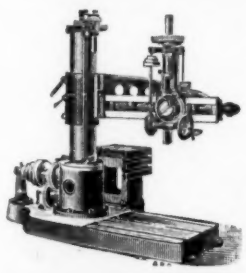

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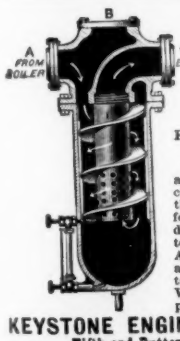

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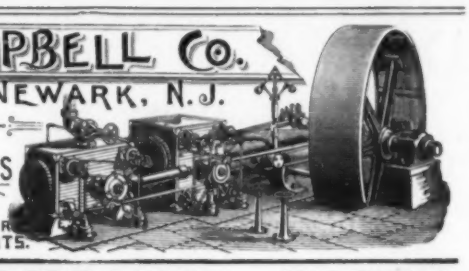

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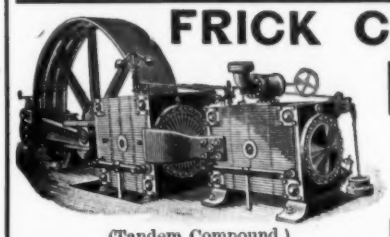

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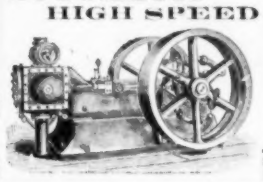

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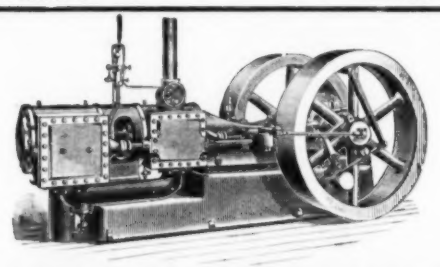

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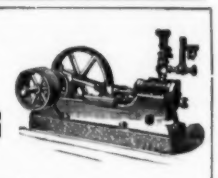

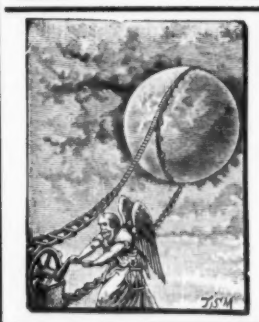

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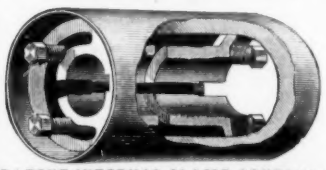

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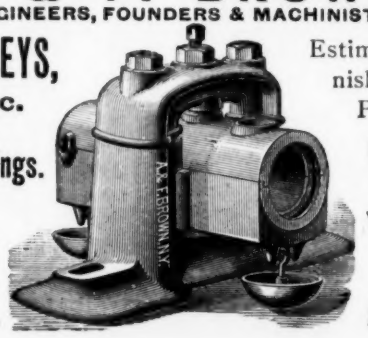

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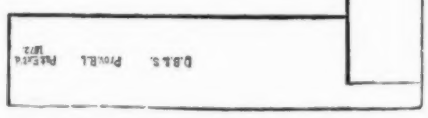

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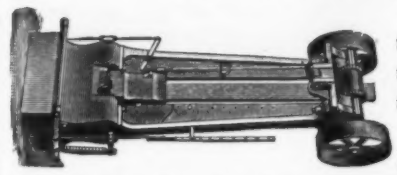

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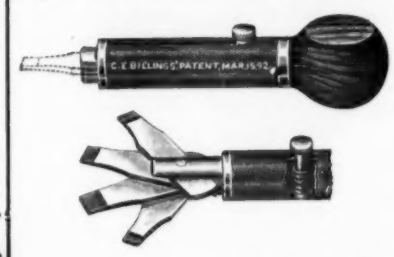

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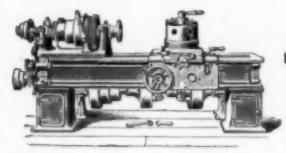

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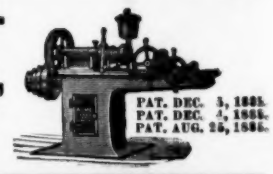

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